The Journal

OF THE

AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

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The Journal of the American Association of Nurse Anesthetists is published quarterly by the American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Ill. Entered as second class matter, May 14, 1945, at the post office at Chicago, Ill., under the act of March 3, 1879. Address all communications relative to editorial and advertising matters to the Editor, 116 S. Michigan Ave., Chicago 3, Ill. Subscription prices: to members, 50c a year; to nonmembers and institutions $1.50 a year; single copies, 50c. The opinions expressed in the columns of the Journal are those of the contributors and are not to be construed as reflecting the views of the American Association of Nurse Anesthetists.

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OPINION REVIEW

HOUSE OF DELEGATES

At the Sixteenth Annual Meeting at Cleveland in 1949 a motion was passed that the opinions in support of and in opposition to a House of Delegates should be made available to the members through publication. In accordance with this directive, the Planning Committee, to which further study of a House of Delegates was assigned in 1949, has prepared the following review of the opinions of individuals and of material collected by the various committees that have studied the organization of a House of Delegates. A report of the investigations of the Planning Committee will also be presented at the business session of the Eighteenth Annual Meeting at St. Louis on September 19, at which time the question of adopting a House of Delegates will be placed before the members. It is not the purpose at this meeting to formulate the working detail of the system, which is a committee function should the plan be adopted.

Function of a House of Delegates.—According to the bylaws of eight organizations investigated, a House of Delegates may or may not be a policy-making or legislation-initiating body, may or may not nominate and elect officers and trustees, may or may not have veto power over policy-making and legislation-initiating action of the Board of Trustees, or administrative body, may or may not have the power to appoint special committees, may or may not have the power to approve committee appointments and create new committees, and may or may not make appropriations. It has the power to amend bylaws and change the constitution. With respect to nominations and elections, the power of nominating may reside in a nominating committee, and officers may be elected by the general membership through a mailed ballot. (The limits of authority of a House of Delegates vary with organizations and must be clearly defined.)

The administrative body, or Board of Trustees, is generally responsible for carrying out the directives of the legislative body, for the disbursement of all funds, and for the approving of all committee appointments by the President from the general membership and of the appointment of the headquarters staff, and it may or may not initiate all or part of the legislation.

In substance, there is no set pattern for the function of a House of Delegates, the respective powers of a House of Delegates and of the Board of Trustees being defined by the bylaws of an organization.

Composition of a House of Delegates.—According to the bylaws of the eight organizations studied, there is also no uniformity in the

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number of delegates proportioned among the members or in the manner in which they are selected. Great responsibility is placed upon the component societies.

The following statements are a composite of opinions that have been expressed with reference to the adoption of the plan by the American Association of Nurse Anesthetists:

A House of Delegates has value in expediting the affairs of a large and complicated association with an unwieldy number of persons attending the annual meeting.

A House of Delegates presupposes well organized and active regional associations, since the selection and instruction of delegates, if instruction is given, rests with the regional associations.

A House of Delegates is said to be a more democratic legislative organization by providing an equitable distribution of voting power among the members. Proponents of this point of view believe that this equity compensates for the increased administrative costs that of necessity follow the adoption of a House of Delegates.

Since there is no single pattern of organization for a House of Delegates, great care must be exercised in the preparation of bylaws that would positively define the body's powers and function in order to avoid overlapping of responsibility and functions of a House of Delegates and the Board of Trustees. Consideration must also be given to providing representation for the sizable number of members who reside in areas without local associations.

In organizations having a House of Delegates a constant vigil must be maintained to keep an even balance between seasoned delegates and new delegates in order to prevent the results of stagnation on the one hand and of unconsidered legislative activity on the other.

In debating the subject of a House of Delegates the following statements and refutations have been made:

A House of Delegates would assure equal representation of each member group in legislative procedures. Some members feel that they are penalized by their inability to attend conventions, and no hospital is prepared to spare all members of its anesthesia staff at one time.

Individual members who attend conventions are reluctant to lose their individual vote. Those members who are interested in association affairs make a special effort to attend conventions. The Association has made good progress with its present form of organization.

It is the duty of the states to prepare themselves to select and instruct the delegates properly.

Component associations are not sufficiently well organized to select and instruct delegates properly with the result that the few members who attend state meetings and the few selected as delegates would control the policies of the Association.

The state associations should select delegates whose judgment

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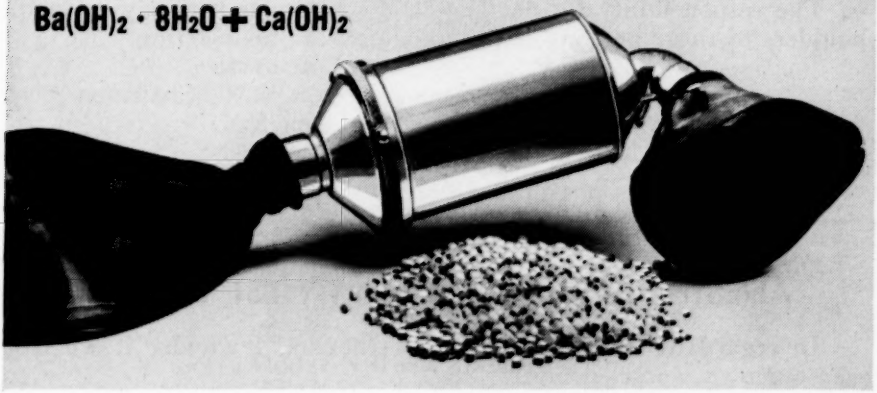

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meeting, the delegates would have no opportunity to receive instruction from their constituents.

The cost of possible additional state association meetings, of sending delegates to the conventions, and of increased administrative work in both the state and national associations should be seriously considered.

The responsibility for deciding this issue rests squarely upon the shoulders of those persons attending the St. Louis meeting.

PLANNING COMMITTEE
Edna Peterson, R.N., Chairman
Verna E. Bean, R.N.
Laura Hoffman, R.N.
Agnes Lange, R.N.

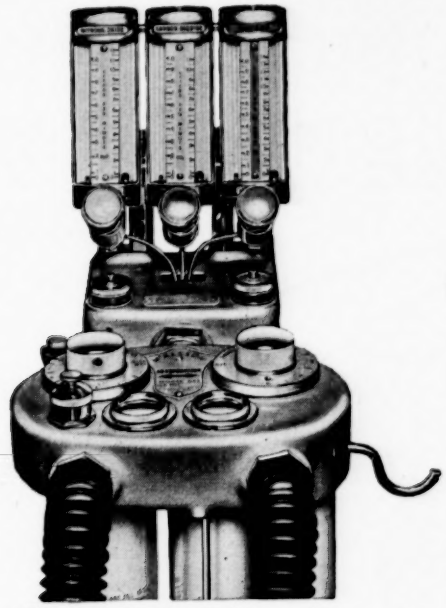
ANESTHETISTS THEIR OWN WORST ENEMIES

In regard to recruiting nurse anesthetists, I wonder if we have been our own worst enemies?

Just recently a former director of nursing said she had never included anesthesia as a special field for nurses in her professional problems classes. On being asked why, her reply was that we shouldn't have to ask. What she said in substance was this:

We have gone on record as boasting that we have gone beyond nursing, even though we use the word "nurse" in the title of our organization. We do not belong to the A.N.A. Many of us have not kept up our nurses' registration. We have repudiated the nursing groups. We have said in referring to the A.A.N.A. and the A.N.A. that we have nothing in common. Yet at the same time we can't help but know that we are holding our jobs by virtue of the fact that we are nurses. Many other groups, for instance, the public health nurses, are not particularly for A.N.A. They are definitely for the National Organization for Public Health Nursing and have a strong association, but they still belong to A.N.A. Why not the anesthetists? What do we have that we are so smug, that we think we can live unto ourselves alone? She concluded that she was and is not the only nursing director who does not include anesthesia as a special field of nursing when talking with nurses.

I think maybe she could be right. We certainly do hold our jobs first and foremost because we are nurses. We also certainly do need more anesthetists. Where do we recruit them? From the ranks of graduate nurses. It follows then that we should uphold nursing. One upholds a cause by one's money, prayers, good works, and presence, and that money might well include A.N.A. dues, and the presence, our being at district nurses' meetings.—HARRIET L. ABERG, R.N. Galesburg, Ill.



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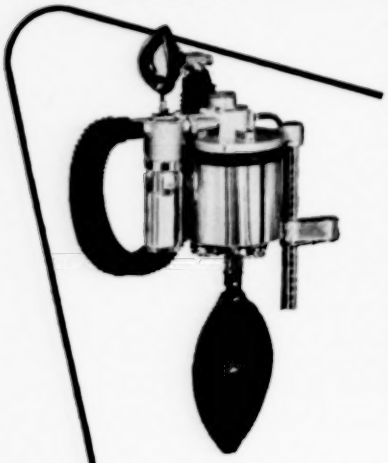

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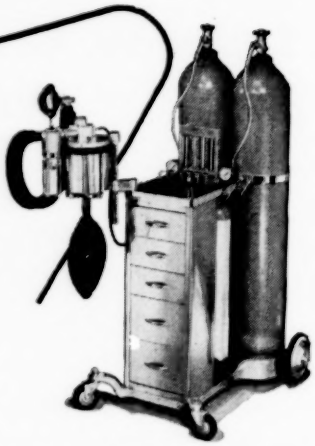

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VOLUME XIX AUGUST, 1951 NUMBER THREE

PERSONNEL PRACTICES

The recognized need for a reference on salaries, working hours, vacations, maintenance, and sick leave led the Board of Trustees of the A.A.N.A. to appoint a committee on Personnel Practices at the last annual meeting. To prepare a guide for the use of hospital administrators and anesthetists desiring information on prevailing personnel practices, the committee conducted a survey of the working conditions of anesthetists in all of the forty-eight states, Alaska, and Hawaii. A creditable number of responses was received, and the committee wishes to express its appreciation to all those who participated in the survey for their prompt co-operation.

The results of the survey indicate that the variations in salary range are not limited to any specific areas. Working hours per week seem to create the greatest stumbling block. Large hospitals that employ a large number of anesthetists seem to be able to keep the working hours and the hours on call at a minimum. Many small hospitals pay on a "per case" basis for extra call. Full maintenance seems to be limited to the small hospitals with few exceptions. Vacations and sick leave seem to depend on tenure of service.

The reports are now being analyzed, and at the Eighteenth Annual Meeting a detailed report will be given of personnel practices affecting nurse anesthetists at a national level. In general, a preliminary study suggests that the possibilities of establishing a standard for personnel practices are favorable, and that an average for salaries, hours on duty, hours on call, maintenance, vacations, and sick leave can be arrived at.—JOSEPHINE BUNCH, R.N., Chairman, Personnel Practices Committee.

OFFICIAL CALL

As provided for in the Bylaws of this association, and at the direction of Verna E. Bean, president, we hereby issue this official call to the members of the annual meeting to be held in St. Louis, September 17-20, 1951, at Kiel Auditorium. The annual business session will be held on Tuesday, September 18.

Accomplished at the Executive Offices, 116 S. Michigan Ave., Chicago 3, Ill., this 28th day of June 1951.

(Signed) FLORENCE A. MCQUILLEN, R.N.

Executive Director

PEDIATRIC ANESTHESIA

C. Marshall Lee, Jr., M.D.*
Cincinnati

It is with considerable trepidation that I stand before this audience today, because for me to do so presents much the same spectacle as might be provided by a chicken trying to teach a fish to swim. My personal experience as an anesthetist has been brief. During my senior year in medical school I had an "externship" in obstetric anesthesia. This was some seventeen years ago, and the strides that the art and science of anesthesiology have made since then are matched only by the alacrity with which I seem to have forgotten the little of it that I knew. I have had a fairly extensive experience with spinal anesthesia. During World War II in remote parts of the Pacific, both afloat and ashore, I administered a good many open drop ether and chloroform anesthesias under a wide variety of unfavorable circumstances, with distractions foreign to the surroundings in which you work. I gave a good many anesthetics intravenously. Local and regional anesthesia I still administer frequently. But the complexities of modern inhalation anesthesia machines are as mysterious to me as the inner workings of a television set. Who, then, am I to discuss pediatric anesthesia with you? I am constrained to apologize for being here at all!

The only excuse I can offer for being here is that I am a surgeon, and skilful anesthetists are as important to me as my scalpel. I am reminded of a biochemistry professor I once had who made free to criticize quite sharply a new textbook of biochemistry that an enthusiastic salesman was trying to sell him for the use of his class. The salesman was piqued by the professor's critical comments and finally he said, "Dr. Jones, did you ever write a textbook of biochemistry?" The good doctor admitted that he had not. "Then," said the salesman triumphantly, "how can you be so critical of this book, when you have never tried to write one?" "My dear young man," said the professor, "I have never laid an egg, but I assure you I can tell a good one from a bad one!"

Thus, as a surgeon I may not be a good anesthetist, but I do know the difference between a well and carefully administered anesthesia and a poor one. With this apology for my presumptuousness, there are a number of comments I would like to make, with particular reference to pediatric anesthesia.

I would not presume to try to tell you how to give an anesthe-

Read before the Annual Meeting of the Ohio State Association of Nurse Anesthetists, Cincinnati, April 4, 1951.

*From the Department of Surgery, University of Cincinnati College of Medicine, and the Surgical Service, Children's Hospital.

tic. If I confine myself to the results, that is, to what surgeons look for, and leave to you the methods of achieving them, I shall be on firmer ground.

All of you are familiar with the criteria for the ideal anesthetic, and I would be wasting your time to repeat them. All of you know that there is no such thing as the ideal anesthetic, and that for every patient and every operation the advantages and disadvantages and dangers of method and agent must be weighed against the conditions obtaining for that particular patient. Without minimizing this fundamental axiom in all applications of anesthesia, it is perhaps nowhere so precariously important as it is in pediatric anesthesia.

PHYSIOLOGIC CONSIDERATIONS

West and Papper,[1] in an article published last year, commented that "much that is practiced seems to be derived from a concept which assumes that a child is simply a small adult who has identical needs and responses to anesthesia and surgery." Let no one who would administer anesthesia to children harbor any such tragic delusion. As Josh Billings remarked, "The trouble with ignorance is not so much what you don't know as what you do know that ain't so."

The child is not a miniature adult. His physiologic stabilizing mechanisms are precariously balanced, easily disturbed, and as incompletely developed as are his soft, cartilaginous, partially ossified bones. Let every anesthetist look at the radiographic film of a newborn infant's arm and remember that the delicate physiologic mechanisms of the infant, which mean the difference between life and death, are as immature and as different from those of the adult as are the curious and unfamiliar structures one sees in the transparency.

Permit me briefly to mention a few of the differences. In the newborn infant weighing 7 pounds the total circulating blood volume is about 350-400 cc., less than a single unit of blood for transfusion to an adult. An infant, aged 1 year and weighing 21 pounds, has about 1,000 cc. blood. The minute volume (cardiac output) in a newborn infant is about 520 cc. per minute (4-5 cc. per systole or "stroke volume"), which, in proportion to size, is about twice that of an adult. The circulation time is estimated at 12-14 seconds, as compared with 22-25 seconds for an adult. It is apparent that anesthetic agents, whether administered by inhalation or by intravenous injection, are rapidly diffused, and the margin of safety is correspondingly narrow.

The tidal air in a newborn infant varies from 16 to 20 cc. at rest to as much as 180 cc. during crying. The dead space in the mask and tubing of a closed circuit machine may be many times the total tidal air volume of a sleeping infant, and it is obvious how easily suffocation can occur. Even the normal resting rate and rhythm of respiration vary enormously from infant to infant during the first few months of life. The normal rate in a newborn infant averages about 40 a minute, but the slightest disturbance of body chemistry or

1. West, J. S., and Papper, E. M.: Preanesthetic medication for children. Anesthesiology 11:279-282, May 1950.

nervous stimulation may destroy all semblance of a normal pattern. One has only to observe the double inspiration of the child sobbing from rage or pain or his remarkable capacity for breath holding in fear or a tantrum to appreciate the extremes of variation in respiration that may be encountered in a child after clumsily induced anesthesia.

The pulse is unstable to a degree. In young children and infants, especially under the stress of induction of anesthesia, the pulse may become uncountable, and 90-100 a minute is the usual rate. To the experienced pediatric anesthetist a pulse rate of 60-70 a minute in a child who has been apprehensive before and during induction should be grounds for serious concern, whereas in an adult it might be considered ideal.

The vagal reflexes are deserving of the closest attention and scrutiny, but time will permit only brief consideration of them. Every medical student remembers that paroxysmal auricular tachycardia may often be arrested and normal cardiac rhythm restored by vagal stimulation. He is taught to pull hard on the patient's tongue or apply pressure over the jugular veins for short intervals. In so doing he is employing the vagus nerve reflex to change the abnormal cardiac rhythm, and the effect is beneficial. It has been shown experimentally that anoxia of even moderate degree will initiate, reinforce, or exaggerate the vagal reflex. Pressure over the jugular veins produces congestion in the cerebral circulation, provokes mild anoxia, and elicits the desired reflex. In paroxysmal auricular tachycardia the result is favorable. But under anesthesia the effect of this reflex on the laboring heart, close to exhaustion, may be to bring about a fatal cardiac arrest. Hence, during any general anesthesia, but especially with an agent such as cyclopropane with its effect on cardiac irritability, the vagal reflexes may be highly dangerous, and their abolition by the preanesthetic use of atropine is highly desirable. The blocking of these reflexes is *not* one of the pharmacologic effects of scopolamine. Verbum sapientibus satis est—a word to the wise.

PREOPERATIVE PREPARATION

In 1948 Katherine Jackson of New York[2] showed that there is a direct correlation between the degree of tachycardia and the apprehension and struggling during the induction period in the child who has not received premedication. She employed nembutal as a preanesthetic basal medication. More recently the rectal administration of pentothal sodium as a preanesthetic hypnotic has been increasingly used and written about.[3-5] The choice of premedication and of anesthetic agent is a subject that merits hours of study and discussion and will not be developed here.[6] The point I wish to stress

2. Jackson, K.: Tachycardia in children during anesthesia. Anesthesiology **9**:573-584, Nov. 1948.

3. Artusie, J. F., Jr., and Trousdell, M.: A comparative study of rectal pentothal and morphine for basal anesthesia upon children for tonsillectomy. Anesthesiology **11**:443-451, July 1950.

4. Mark, L. C.; Fox, J. P., and Burstein, C. L.: Preanesthetic hypnosis with rectal pentothal in children. Anesthesiology **10**:401-405, July 1949.

5. Schotz, G.: Rectal pentothal for basal narcosis in infants. Anesth. & Analg. **21**:295-299, 1942.

6. Leigh, M. D., and Belton, M. K.: Special considerations in the selection and employment of anesthetic agents and methods in infants and children. Anesthesiology **11**:592-598, Sept. 1950.

from the surgeon's standpoint is the importance of well selected preanesthetic medication in proper dosage. In the essentially healthy child the induction of anesthesia, such as for tonsillectomy, is dangerous enough. But in the infant or toddler with acute intestinal obstruction from intussusception, volvulus, and so forth, or with a cardiac anomaly where physiologic balances are seriously disturbed, or in the accident case when an operation must be performed soon after a full meal, the hazards are increased many times. Like the take-off and landing of an airplane, the induction and recovery periods are perhaps the most dangerous phases of anesthesia.

The nurse anesthetist is in a position slightly different from that of the medical anesthesiologist, and in many clinics, including our own, this is regarded as an advantage. No reflection on my medical colleagues in anesthesiology is intended by this remark, for they command and deserve the highest professional respect. Through their efforts in research and clinical anesthesia anesthesiology has made tremendous advances in the past fifteen years and is keeping pace with progress in other fields of medical endeavor. By reason of their specialized background of training and experience, it is to them that the nurse anesthetist must look for guidance and judgment in the evaluation and use of new agents and technics. In many hospitals the nurse anesthetist works under the direction of a medical anesthesiologist. In others she works independently. Regardless of the circumstances of her work she merits the complete confidence and respect of her professional associates, whether they be nurses, surgeons, or other physicians. Under the law she is not and should not be licensed to practice medicine, any more than a physician is licensed to practice nursing. Yet she has gone into a highly specialized field beyond the ordinary range of nursing practice and bordering on the practice of medicine. This she can do only under the license of the surgeon with whom she works and who is responsible, through her, to the patient. Her responsibility to the patient and especially to the surgeon is therefore an especially grave one, and herein lies her greatest advantage as well as her greatest danger.

It is the nature of human affairs where matters of serious import are concerned that there can be no ultimate division of final responsibility. Every organization, whether large or small, be it political, economic, military, or scientific, must have the final responsibility vested in the hands of one person. In the care of the surgical patient the final responsibility must rest with the surgeon. And yet, as was suggested at the outset, he is powerless to serve his patient without associates whose special skills are as essential as the instruments he uses. He must have confidence in the operating room nurses, whose failure to provide sterile supplies and equipment, to see that the right thing is available at the right time, and to keep the operating room running smoothly in a thousand different ways would nullify completely his best efforts and most dedicated skill and judgment. His dependence on his nurse anesthetist, though comparison is impossible, is per-

haps even greater. The old axiom about the chain and its weakest link is nowhere so precisely applicable as it is to the team responsible for the patient on the operating table. And nowhere is it so essential for two individuals to co-operate perfectly as it is for the surgeon and the anesthetist. Let no one, in spite of the relative responsibilities, fail to appreciate the importance of the anesthetist or of her responsibility to the surgeon and the patient.

In the relationship between the surgeon and his nurse anesthetist it is necessarily the surgeon's responsibility to see that the patient comes to the hands of the anesthetist with every possible preliminary safeguard taken and to see that all of the information needed by the anesthetist for this purpose is available to her.

He must make certain that the stomach has been emptied of food, gas, or regurgitated intestinal contents. He must order appropriate premedication in proper dosage and administered far enough in advance to be fully effective, so that this may be evaluated in relation to the subsequent anesthesia. He must know and record for the anesthetist's information not only the surgical condition of the patient but also his general condition, including the necessary laboratory studies. He must plan for existing and potential needs for the parenteral administration of fluids, blood, and plasma and for other supportive measures, such as conservation of body heat or cooling when this is indicated. These are all part of his multiple responsibilities even before the anesthesia is begun or the operation started. They are fundamental to every anesthesia or operation, but in pediatric anesthesia they are especially important. I am reluctant even to mention the word "routine." It has no place in the preparation of any patient for anesthesia and operation, for such preparation must be individualized to suit the individual case. But in pediatric surgery the word is an anathema indeed. There can be no such thing as a "routine," for not only do the general condition and surgical condition of the patient vary tremendously from case to case, but even in the so-called normal child differences of age, weight, and temperament present special needs in every case.

The careful surgeon must be doubly careful when he is dealing with a child, where the margin of safety, case for case, is so much narrower than it is in the adult. One can only call that surgeon stupid who, through egotism or foolish pride, does not welcome the help of the nurse anesthetist who checks for him again each of the items previously mentioned in the preparation of the patient. It is a part of her responsibility to go through the patient's record well before the scheduled time for operation, the night before if possible, and see that nothing has been overlooked. The farther ahead she can do this, the more time there is to correct any unintentional omissions. Nor is this the only reason for such a preliminary visit by the anesthetist. To the child from 6 months of age on up, a stranger in a strange place is a fearsome thing. A preliminary visit from the anesthetist to gain his confidence and become a recognized friend is much more important, from the child's standpoint, than

a visit from the surgeon. It is as well for him not to see the surgeon, gowned, capped, and masked, for he cannot possibly associate him with the man in ordinary dress who examined him and talked with him before he was taken to the operating room. But he can and should recognize the nurse anesthetist who talked with him before and who, in the induction room, needs no mask or other frightening disguise. If he has been properly premedicated and prepared, it should be possible for the induction to proceed with such complete lack of fear that two days later he will have no memory of it, or, if he has any, it should not be unpleasant. The nurse anesthetist has a great advantage here, for most children will, through association with their mothers, accept another woman, if she is friendly and sincere, more readily than they will a strange man. And here, though I am sure each of you is already aware of it, it is worth emphasizing that those who handle children best are those who are genuinely fond of them and whose approach is really affectionate. The child is the smartest psychologist in the world, and nine times out of ten he will instantly detect and fear a synthetic or excessively effusive approach. He is acutely sensitive to indecision or nervousness in an adult and immediately becomes apprehensive himself. A casual but genuinely friendly manner does more to gain his confidence than all the "planned approaches" in the world.

We have dealt thus far, in a general way, with the preparations for anesthesia. One might dwell at equal or greater length on the actual anesthesia and operation and immediate postoperative and postanesthesia care. To do so would prolong this presentation unduly and overstrain your commendable and deeply appreciated patience and attention.

SURGEON-ANESTHETIST RELATIONSHIP

To deal briefly with this phase of the subject I have compiled a list of what appear to me to be the proper duties and responsibilities of the surgeon and the nurse anesthetist to each other and to the patient during the course of any operation.

A. **Responsibilities of the nurse anesthetist**

1. To be in complete readiness when the surgeon arrives but not to start the anesthesia until he instructs her to do so.
2. To give her undivided attention to the administration of the anesthesia and to the reactions and responses of the patient.
3. To keep an accurate record of the measurable physiologic reactions, such as respiration, pulse, and blood pressure.
4. To note and report to the surgeon *at once* the slightest deviation from the course to be expected under the circumstances, such as cyanosis, change in respiratory rate or rhythm, and alteration of the pulse. This does not mean that repeated "alarums and excursions" are necessary. A nervous anesthetist is not a good anesthetist. She needs only to report in a quiet and assured manner and give the surgeon an opportunity to pause and evaluate the situation in relation to what he is doing.

5. To consult with the surgeon when in her judgment added medication, such as atropine, morphine, or curare, is indicated, and never to give it without his prior knowledge and consent.

6. To keep an eye, if possible, on continuous intravenous drips and report approaching depletion, interruption of flow, or excessive speed of administration. This responsibility is shared with the scrub nurse, the circulating nurse, and the surgeon's direct assistants and is always secondary to close attention to the anesthesia and the patient.

7. To avoid in the most scrupulous manner joking, laughing, unnecessary talking, humming, whistling, and similar distractions. It goes without saying that every operation, whether large or small, is not a social event but partakes of the very nature of a prayer to Almighty God. Let no one make light of it!

8. To keep her temper and self control at all times regardless of provocation or accident. This may be, perhaps, the hardest rule of all to observe, for surgeons under stress are all too often not the gentlemen they should be. I do not defend this trait or excuse it. But I am sure you would be the last to deny that you have observed it—at least occasionally!

B. **Responsibilities of the surgeon**

1. To give his anesthetist as much time as she needs for preparation and induction. This means that he must arrive well ahead of the scheduled operating time and advise the anesthetist of his presence so that she may start the anesthesia. He should not stand impatiently around muttering, "Let's go!" or "Put him down." He should neither interfere with the induction by premature preparation of the operative site nor make his incision without first asking the anesthetist if she is ready.

2. To appreciate and respect the skill and good judgment of the anesthetist and never to disparage or dismiss her reports and recommendations. He should give them the same careful consideration and judgment that he would if the observations were his own.

3. To keep the anesthetist informed, in advance if possible, of any step in the operation that may unexpectedly affect the course of the anesthesia or the condition of the patient. He should know when an approaching phase may be unavoidably shock producing and give the anesthetist time to prepare for it. He should tell her in advance when he is about to open the pleura or peritoneum or when he is ready to use the cautery. If there is undue or unexpected blood loss, he should report it to her.

4. To avoid "joking, laughing, unnecessary talking, humming, whistling, and similar distractions." This is all too often a cover for nervousness or inexperience and is usually recognized for what it is. The inappropriateness and bad taste of such behavior have already been commented upon and apply equally to the surgeon, the anesthetist, and all others in the operating room.

5. To keep his temper and self control at all times regardless of provocation or accident. This may be just as hard at times for the surgeon as it is for

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REBREATHING AS A BASIS FOR CLASSIFICATION OF INHALATION TECHNICS

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In the field of anesthesia both the literature and the discussions of anesthetists about anesthesia seem to be characterized by a curious sort of semantic confusion. At times it seems as though there are as many terms used for certain technics as there are anesthetists using the technics. Consider, for instance, assisted, augmented, aided, and compensated respiration; or continuous, serial, and fractional spinal anesthesia or, if you prefer, spinal analgesia, to mention but two many named technics. Nowhere is this semantic confusion more evident than in the classification of the various inhalation technics. For example, one technic is called semiopen, and another is called semiclosed — a dubious distinction, not only from the semantic standpoint but from the technical standpoint as well, since that which is called semiopen is often more closed than that which is called semiclosed. There is even confusion about the term "inhalation" itself. It is used in one sense to mean the method of producing anesthesia by introducing an anesthetic into the blood by way of the respiratory tract.[1] It is also used to distinguish a certain technic of intratracheal anesthesia from another technic called intratracheal insufflation, which is itself an inhalation technic,[2] and we thus arrive at a technic which could be called the intratracheal inhalation technic of the inhalation technic.

This semantic jumble probably stems from three sources. One source is our adherence to the use of old and long familiar terms in the face of the accumulation of terms added to the language as new technics have been developed. We have not, apparently, re-examined the old terms and the technics these terms symbolize in the light of newer knowledge to determine whether the terms as we use them are adequate and accurate for use at the present time. Another source of semantic confusion is our tendency to identify technic of administration with anesthetic agent or to identify technic with apparatus. This habit of identification, together with the failure to re-evaluate analytically the accreted language of anesthesia, has led to the third source of the semantic jumble, i.e., the failure to classify technics on the basis of a single unifying principle.

It is the purpose of this article to examine one common factor

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1. Adriani, John: *Techniques and Procedures of Anesthesia* (Springfield, Ill.: Charles C Thomas, 1947) p. 3.

2. Gillespie, Noel A.: *Endotracheal Anaesthesia* (Madison, Wis.: University of Wisconsin Press, 1948) p. 4.

in inhalation technics that could serve as a basis for classification, but, because our habit of identification has been largely responsible for our present haphazard classification of inhalation technics, a few illustrations of this habit and its consequences seem to be indicated. Since this habit is not restricted to inhalation anesthesia alone, some of the illustrations will deal with other technics of administration.

Identification of Technic with Anesthetic Agent

The tendency to identify a technic of administration with a particular anesthetic quite naturally occurs most often in those instances in which an anesthetic is more commonly given by one technic than by another. For example, some anesthetists use the term "intravenous anesthesia" as a synonym for pentothal sodium. A paper or a lecture entitled "Intravenous Anesthesia" all too often turns out to be a discussion of the drug pentothal sodium in spite of the fact that numerous other anesthetics can be given by the intravenous technic and that pentothal sodium can be given by another route of administration. Even in some of the books on anesthesia the term "intravenous anesthesia" is used interchangeably with barbiturate narcosis. For example, Hewer[3] wrote in a discussion of contraindications for barbiturates, "Intravenous anesthesia should not be used for bronchoscopy. . . ."

Another common identification is that of the open drop technic with di-ethyl ether. So naturally does the word "ether" follow the words "open drop" that, even in texts in which it is pointed out that any volatile liquid anesthetic can be given by this technic, the word "ether" slips unobtrusively into the place of the word "anesthetic" in the discussion of the principles of the technic. And often in lists of disadvantages of the technic the disadvantages given are actually those of ether and not of the technic itself. This identification of ether with the open drop technic, together with the fact that ether, when given by semiclosed or closed technics, is often used with nitrous oxide, has seemingly led to the assumption that the use of ether precludes the use of high oxygen concentrations. At least, such is the impression given by those who state that cyclopropane is preferable to ether in certain instances because cyclopropane permits the use of high oxygen concentrations. Consideration of the anesthetic concentrations of these two agents and more careful distinction between agent and technic of administration should encourage the use of more valid reasons for the preference for cyclopropane.

Identification of Technic with Apparatus

The process of identification has not been limited to technic and agent but has also extended to technic and apparatus. For example, a gas machine seems to imply closed carbon dioxide absorption or semiclosed technic, although it can be used under circumstances in which there is less rebreathing than in the so-called open drop technic. Carbon

3. Hewer, C. Langton: *Recent Advances in Anaesthesia and Analgesia*, (Philadelphia: The Blakiston Co., 1948) p. 144.

dioxide absorption is inseparably linked to the closed technic, and one finds descriptions of the semiclosed technic in which it is stated that the disadvantage of this technic is that it allows accumulation of carbon dioxide. For example, in the book *Fundamentals of Anesthesia*[4] the statement is made in the discussion of the semiclosed technic that "partial rebreathing . . . causes carbon dioxide to build up in the blood." Hewer[5] made a similar statement about partial rebreathing and said that the combined gas flow must be kept above 5 L. per minute so that carbon dioxide equilibrium may be maintained. These two statements are typical examples of the failure to reevaluate old technics and to redefine old terms in the light of new developments in anesthesia. To be sure, partial rebreathing would cause carbon dioxide retention if used without a carbon dioxide absorber, but it is just as possible to use carbon dioxide absorption with a partial rebreathing technic as it is to use it with a total rebreathing technic with any gas machine equipped for carbon dioxide absorption.

PRESENT CLASSIFICATIONS OF INHALATION TECHNICS

In the attempt to classify the various inhalation technics we seem to have become hopelessly entangled with the many gadgets we use to convey the anesthetic into the patient's respiratory tract. As a result of this entanglement with gadgets the classification of inhalation technics is approached from at least three or four bases.

Classification according to site of entrance of the agent into the respiratory tract.—One classification seems to be based on the site at which the anesthetic is delivered into the respiratory tract. We hang a metal hook over a patient's lip and call the technic oral; if the anesthetic agent is delivered by way of a catheter passed through the inferior meatus of the nose, the technic is called pharyngeal or endopharyngeal. If an ordinary face mask is used, we apparently lose interest in the site of entrance of the agent into the respiratory tract, but it is probably just as "oral" and just as "pharyngeal" as with the other devices.

Classification according to type of machine.—Another classification is based on the type of machine used to deliver the agent, but here the lines are not clearly drawn. The technic called insufflation seems to be related to a particular type of equipment in which a volatile liquid is vaporized by air, oxygen, or other gases and is "blown into the mouth, pharynx or trachea."[6] Gillespie[7] described intratracheal insufflation as a technic in which "anaesthetic vapors are forced into the trachea by positive pressure through a narrow-bore tube whose end lies close to the bifurcation." On the other hand, when a gas machine is used in a fashion similar to that of the insufflator, the technic may be called semiclosed. Gillespie[8] described, under the heading *semiclosed*

4. Subcommittee on Anesthesia of Division of Medical Sciences, National Research Council: *Fundamentals of Anesthesia* (Chicago: American Medical Association Press, 1944) p. 78.
5. Hewer, C. L.,[3] p. 68.
6. Subcommittee on Anesthesia,[4] p. 74.
7. Gillespie, N. A.,[2] p. 4.
8. Gillespie, N. A.,[2] p. 137.

methods, a technic for attaching an intratracheal tube to a gas machine and pointed out that the rate of flow of gases must be equal to the minute volume of respiration to insure the elimination of carbon dioxide. With a total flow rate equal to minute volume, such a technic, especially when used with an intratracheal tube, should permit very little, if any, rebreathing and could more properly be called open than semiclosed. Moreover, the distinction between this technic and the technic called intratracheal insufflation is not clear. Gillespie defined the intratracheal inhalation technic as one in which anesthetic vapors are delivered into a wide bore intratracheal tube from a bag at atmospheric pressure. In the so-called semiclosed technic described previously the flow rates are kept equal to the respiratory minute volume, which would mean that flow rates of from 6 to possibly 10 L. would be needed for an average adult. Gases flowing at these rates exert more than atmospheric pressure, and yet Gillespie called this technic an inhalation technic. If, however, this same technic is used with an intratracheal tube without a cuff, it is called inhalation "with some degree of insufflation."[9]

This overlapping use of the terms "inhalation" and "insufflation" illustrates well how our casual semantic habits have tended to obscure the basic principles of technics, and it is therefore pertinent to examine more thoroughly these technics as defined by Gillespie. These are the essential features of the two technics: The insufflation technic employs a small bore tube and gases under positive pressure. The inhalation technic employs a wide bore tube through which the patient inhales and *exhales*, and the gases are administered at atmospheric pressure. Since the semiclosed technic described previously utilizes high flow rates of gas, it would seem that the crucial distinction between insufflation and inhalation does not rest on the pressure or flow rate at which the gases are administered, but rather on the bore of the intratracheal tube used.

There is no doubt at all but that Gillespie's distinction between these two technics is sound, since he emphasizes the danger of the development of constant positive pressure in the lungs by flowing gases into the trachea at high flow rates through a small bore tube, but the term "insufflation" does not adequately suggest why this should occur. It tends to concentrate attention on the manner in which the gases enter the respiratory tract rather than on the fact that provision must be made in any technic for unhampered expiration.

Classification according to amount of rebreathing.—The classification of two technics, the semiclosed and the closed, has been based on the amount of rebreathing permitted. To a certain extent, the open and semiopen drop technics are also classified according to this basis, but a new idea is added by the word "drop," which offers still another basis for classification, i.e., the method used to get the liquid agent into position for vaporization.

9. Gillespie, N. A.,[2] p. 138.

SOME RESULTS OF IDENTIFICATION OF TECHNIC WITH AGENT AND WITH EQUIPMENT AND THE HAPHAZARD CLASSIFICATION OF INHALATION TECHNICS

It was said earlier that the habit of identification of technic with agent and with equipment was a cause of the confusion that characterizes the language of anesthesia. Because of this habit, we have failed to distinguish clearly between factors that are inherent in the technic of administration and those that are inherent in the physical, chemical, and pharmacologic properties of the anesthetic agent. The failure to make distinctions between technic and anesthetic agent has tended to obscure the basic principles underlying the technic and those underlying the action and use of the agent. Because we have not concentrated on basic principles, we have confused technic of administration with the equipment used for the technic. The haphazard classification of inhalation technics, which is the result of inattention to basic principles, in turn further obscures the basic principles. To the experienced anesthetist such things as multiple definitions of terms, identification of technics with anesthetic agents, and haphazard classifications of technics may not seem of serious consequence, but our semantic carelessness does have certain unfortunate effects.

First, because it fails to emphasize important physiologic and physical principles, it presents serious problems in the teaching of students. The failure to emphasize common basic principles makes it unnecessarily difficult for the learner to perceive the relationships between one technic and another and one agent and another and may even delay his or her understanding of certain important principles of anesthesia.

Second, our semantic carelessness permits a vagueness that may lead to misunderstanding even among experienced anesthetists. A typical example of such ambiguity is the following recommendation from *Recommended Safe Practice for Hospital Operating Rooms*[10]: "The use of rebreathing techniques in administering combustible anesthetic agents at *all* times is highly desirable, in order to confine the hazardous gas mixture as much as possible." On the basis of the phrase "in order to confine the hazardous gas mixtures . . . ," it could be assumed that "rebreathing techniques" refers to the closed carbon dioxide-absorption technic. On the other hand, since inhalation technics may employ partial or total rebreathing, and since the word "rebreathing" in the foregoing quotation is not qualified, this recommendation may be interpreted to mean that the so-called semiopen drop technic, the semiclosed technic, and the closed carbon dioxide–absorption technic may be used with equal safety.

This semantic carelessness may have another effect. Because it tends to dull the habit of careful analysis, we may take the inhalation technics more or less for granted and fail to subject them to the extensive laboratory and clinical investigations they deserve. Actually, very little is known yet about such important

10. Committee on Gases and Committee on Hospital Operating Rooms: *Recommended Safe Practice for Hospital Operating Rooms* (Boston: National Fire Protection Association, 1950) p. 20.

technics as the semiclosed and the closed carbon dioxide absorption. A few studies of the closed carbon dioxide–absorption technic have been reported, but much work remains to be done on such factors as oxygen concentrations and resistance, as well as on carbon dioxide concentrations.

Amount of Rebreathing as a Basis for Classification of Inhalation Technics

In order to emphasize the fundamental physiologic and physical principles underlying the inhalation technics, a common unifying principle must be found on which to base the classification of technics. Neither the site of entrance of the anesthetic into the respiratory tract nor the apparatus used to deliver the anesthetic provides this common principle. Probably the only factor in inhalation anesthesia that properly emphasizes the important physiologic and physical factors inherent in the technics is the amount of rebreathing permitted by the technic. There are four fundamental problems involved in any inhalation technic: (1) production and maintenance of adequate anesthetic tensions in the inspired atmosphere, (2) maintenance of adequate oxygen tensions, (3) maintenance of normal carbon dioxide tensions, and (4) prevention of increased resistance to breathing. Although other factors are involved, the amount of rebreathing permitted by the technic of administration influences the solution of the first three problems and is probably a factor in the solution of the fourth. It would seem therefore that if inhalation technics were classified on the basis of the amount of rebreathing, some of the basic principles involved in the solution of these three problems would be more clearly emphasized.

Definition of Term Rebreathing

Since there seems to be a tendency to associate the word "rebreathing" with carbon dioxide accumulation, it is advisable to review the definition of rebreathing. The word "rebreathe" means literally "breathe back" or "breathe again," and it is important to keep in mind that the rebreathed atmosphere has essentially the same composition as that exhaled. Thus, the rebreathed atmosphere may contain several different gases. While it is true that rebreathing can result in higher carbon dioxide concentrations than are normally present in the inspired air, it must be kept in mind that, under certain conditions of inhalation anesthesia in which provision for carbon dioxide elimination is made, it is quite possible to employ total rebreathing without an increase in carbon dioxide concentrations in the inspired air. This might be possible, for example, with technics employing controlled, or assisted, respiration in which an intratracheal tube is used and the anesthetic administered with the closed carbon dioxide-absorption technic.

Factors Influencing the Amount of Rebreathing

The amount of rebreathing that takes place in inhalation anesthesia is influenced by two factors: (1) the total volume of gases delivered into the respiratory tract and (2) the extent of increase in dead space produced by the anesthetic apparatus.

Both of these factors must be considered in evaluating the amount of rebreathing.

Relationship of total flow rate of gases to amount of rebreathing.—The primary factor influencing the amount of rebreathing is the total volume of gases, i.e., the total flow rate of gases, delivered into the respiratory tract. It is essential in determining the amount of rebreathing to think in terms of the total flow rate rather than in terms of the pressure exerted by combined gas flows. The confusion between insufflation and semiclosed technics apparently stems partly from thinking of insufflation as a positive pressure technic, i.e., as a technic in which the gases are delivered under positive pressure into the respiratory tract. Because of the development of controlled and assisted respiration technics in which gases are administered at *low* flow rates with *total rebreathing* but with intermittent positive pressure, it has now become even more important to emphasize total volume of gas flow rather than pressure.

The amount of rebreathing varies inversely with the total flow rate of gases. If the total volume of gases supplied per respiration is equal to or in excess of the tidal volume there should be no rebreathing—provided, of course, that provision is made for unimpeded expiration at a point close to the patient's respiratory tract. If the total volume of gas supplied per respiration is less than the tidal volume, a certain proportion of the expired atmosphere must be rebreathed to make up the required tidal volume. Thus as the total volume of gas supplied per respiration decreases, the amount of rebreathing increases. In practice it is more convenient to estimate the amount of rebreathing on the basis of the respiratory minute volume than on the basis of tidal volume, because flowmeters on most gas machines are calibrated in terms of volume of flow per minute. Obviously, since most gas machines are not equipped with devices for measuring tidal volume, and since a patient's tidal volume may vary considerably during anesthesia, any estimate of the amount of rebreathing on the basis of flow rate is merely an approximation.

Relationship between dead space and rebreathing.—The second factor that influences the amount of rebreathing is the extent to which dead space is increased by the anesthetic apparatus. Any increase in dead space above that of the normal capacity of the anatomic dead spaces increases rebreathing, but in the evaluation of anesthetic technics the term "dead space" must be carefully defined. An increase in dead space is generally associated with two effects: (1) a decrease in the oxygen concentration and (2) an increase in the carbon dioxide concentration in the inspired air. From the standpoint of anesthetic technics and apparatus, the definition of dead space should be based on alterations in the oxygen concentration and/or carbon dioxide concentration in the inspired atmosphere rather than on any characteristic of construction of the apparatus. For example, the atmosphere in a Ferguson mask used for an ether anesthesia may be deficient in oxygen and may contain a higher than normal carbon dioxide concentration. The area of

the mask could properly be considered as increased dead space. On the other hand, if an ether-oxygen anesthesia is given by closed carbon dioxide–absorption technic with the anesthetic delivered into the respiratory tract by an intratracheal tube, the atmosphere delivered to the patient should contain a higher than normal oxygen concentration and (if the apparatus is properly constructed and functions properly) a normal concentration of carbon dioxide. Thus no part of the circle absorber unit should be considered as increased dead space.

In attempting to estimate the amount of rebreathing with any inhalation technic, both of these factors—the total flow rate of gases and the extent of increase in dead space—must be considered together. It cannot be assumed on the basis of flow rate alone that there would be no rebreathing if a flow rate equal to the respiratory minute volume was administered by means of a face mask that increased dead space. Molyneux and Pask,[11] who studied the relation between the flow rate of gases delivered from the flowmeters and the volume of gas breathed back into the reservoir bag of a semiclosed system, reported that a small portion of the exhaled gases are rebreathed unless the flow rate is in excess of the respiratory minute volume. They estimated that a flow rate of 14 L. per minute would be necessary to limit the amount of exhaled gases reaching the reservoir bag to 150 cc. if the tidal volume was 500 cc. and the respiratory rate was 25 per minute. The authors did not give estimates of flow rates required to limit rebreathing when dead space is increased, but it is possible that higher flows would be required if a completely open technic is desired.

On the other hand, a technic such as the so-called oral or pharyngeal insufflation technic, in which there is no increase in dead space but in which the volume of gases delivered is less than the respiratory minute volume, may be characterized by no rebreathing and hence may be regarded as an open technic.

Effect of Rebreathing on Anesthetic Concentration

As stated earlier, the problems involved in maintenance of adequate anesthetic tensions, adequate oxygen tensions, and normal carbon dioxide tensions are influenced by the amount of rebreathing employed. The solution of only one of these three problems—the production and maintenance of adequate anesthetic tensions—is simplified by rebreathing, and even this problem is not simplified in the case of the less potent gases, nitrous oxide and ethylene. Although economy in the use of anesthetics is not the major criterion for evaluation of a technic of administration, rebreathing does tend to conserve the agent. It probably also tends to lessen the fire hazard since the amount of agent dispersed into the room air should be less as the amount of rebreathing increases.

Effect of Rebreathing on Oxygen Concentration

The problem of maintaining adequate oxygenation becomes

11. Molyneux, L., and Pask, E. H.: The flow of gases in a semi-closed anaesthetic system. Brit. J. Anaesth. **23**:81-91, April 1951.

more difficult as the amount of rebreathing increases. Crowley, Faulconer, and Lundy[12] demonstrated the effects of rebreathing on oxygen concentrations in their study of the factors influencing the percentage of oxygen in mixtures of nitrous oxide and oxygen. Although their investigations were limited to the study of nitrogen-oxygen mixtures and nitrous oxide-oxygen mixtures, it seems reasonable to assume that their findings can be applied validly to other gas mixtures. In their studies, in which carefully controlled concentrations and flow rates of nitrogen and oxygen were used, continuous evaluations were made with a Pauling model C oxygen meter of the oxygen content of the gas mixtures delivered from a standard gas machine to the subject. They found that during the first few minutes dilution of the bag mixture by nitrogen from the patient's lungs caused a considerable reduction in the percentage of oxygen received by the patient. The reduction in the percentage of oxygen became less and was of shorter duration as the rate of flow of the gas mixture increased. They also found that in all cases the percentage of oxygen eventually tended to level off at a point that had some relationship to the rate of flow of the mixture. The higher the rate of flow, the more closely did this level approach the oxygen percentage of the original mixture of gas.

These workers emphasized the danger in the administration of mixtures of nitrous oxide and oxygen at low rates of flow and pointed out that "the maintenance of high total flow rates becomes more important as the percentages of oxygen in the original gas mixture become lower." The following figures taken from one of the graphs in their report illustrate the importance of this point. With a gas mixture of nitrogen 80 per cent and oxygen 20 per cent, delivered at a flow rate of 11.53 L. per minute, the oxygen concentration was reduced to approximately 18 per cent after about five minutes; with a flow rate of 5.23 L. per minute the oxygen concentration was reduced to approximately 15 per cent in about six minutes; at a flow rate of 1.48 L. per minute the oxygen concentration after about six to seven minutes had reached approximately 10 per cent.

From the results of this study it appears evident that the lower the total flow rates used, or, in other words, the greater the amount of rebreathing permitted, the greater becomes the problem of maintaining adequate oxygenation. Thus, when a technic that employs total rebreathing is used, such as closed carbon dioxide absorption, it is imperative that some provision be made for the elimination of nitrogen by the use of an open technic (i.e., by the use of high flow rates) before the circuit is closed and/or by starting anesthesia with an excess of oxygen in the gas mixtures.

It is admittedly hazardous to conjecture about one technic on the basis of a study of another technic, and it is to be hoped that these or other investigators will study the problem of oxygen concentrations with the closed

12. Crowley, James H.; Faulconer, Albert, Jr., and Lundy, John S.: Certain factors influencing the percentage of oxygen in mixtures of nitrous oxide and oxygen. Anesth. & Analg. **27**:255-261, Sept.-Oct. 1948.

carbon dioxide–absorption technic. However, since the impression is sometimes given in descriptions of the closed carbon dioxide–absorption technic that this technic provides adequate oxygenation without too much effort on the part of the anesthetist, and that all that is necessary is to supply just the so-called basal oxygen flow of 300 to 450 cc. per minute, it might be permissible to examine this total rebreathing technic in the light of the findings of Crowley and his co-workers.

For the purposes of illustration, let us consider a nitrous oxide-oxygen-ether anesthesia in which the rebreathing circuit is filled with a mixture of 80 per cent nitrous oxide and 20 per cent oxygen and induction is started with the same mixture delivered at a total flow rate of 3 L. Ether is added to the anesthetic mixture and the system is closed five minutes after induction is started. According to these workers, dilution by nitrogen should reduce the oxygen concentration to approximately 14 per cent by this time. Let us assume that oxygen is added to the system at the basal oxygen flow, i.e., at about 300 cc. per minute. Theoretically, if the patient's respiratory rate were 20, this amount of gas flowing *per minute* would supply about 15 cc. of oxygen per respiration. The remaining gas required to satisfy a normal tidal volume of 500 cc. must be supplied from the rebreathing bag. If the oxygen concentration in the rebreathing bag is 14 per cent, the addition of 15 cc. of oxygen to that contained in about 485 cc. of the gas mixture will raise the oxygen concentration to about 14.4 per cent.

It is doubtful, however, that the partial pressure of oxygen in this mixture would be even as high as that exerted by 14.4 per cent oxygen, because of the presence of ether vapor in the gas mixture. Faulconer and Latterell[13] showed that with the semiopen air-ether method of administration the partial pressure of oxygen is reduced in proportion to the increase in the partial pressure of ether. Since this finding illustrates a well known property of gases, it seems fairly safe to transfer it to the closed carbon dioxide–absorption technic and to assume, until proved otherwise, that the addition of ether vapor or any other gas will tend to alter the partial pressure of oxygen in the original gas mixture.

For the purposes of illustration, we started this anesthesia with a "normal" oxygen concentration of 20 per cent and found that it had been reduced to about 14 per cent within a few minutes. If a technic is used such as one suggested in a text on anesthesia, in which the rebreathing circuit is filled with nitrous oxide only and induction accomplished with a mixture of nitrous oxide-oxygen containing about 11 to 12 per cent oxygen administered at a total flow rate of about 4 L., it seems probable that the oxygen deficit could hardly be rectified by the addition of oxygen at 300 cc. per minute after the system is closed.

This illustration cannot be taken too literally since it is impossible, because of the many variables involved, to make such

13. Faulconer, Albert, Jr., and Latterell, Kenneth E.: Tensions of oxygen and ether vapor during use of the semi-open, air-ether method of anesthesia. Anesthesiology 10:247-259, May 1949.

assumptions about concentrations in any gas mixture. However, since the hazards of anoxia are great, it would seem safer to apply the findings of Crowley and co-workers to total rebreathing technics and to take such steps as we can to provide adequate oxygen concentrations when using the closed carbon dioxide–absorption technic.

EFFECT OF REBREATHING ON CARBON DIOXIDE CONCENTRATION

Rebreathing not only complicates the problem of maintaining adequate oxygen concentrations, but it also increases the difficulty of maintaining normal carbon dioxide concentrations in the inspired atmosphere. With any technic that permits more than minimal rebreathing, some provision must be made for the removal of carbon dioxide. Although opinions vary about the use of carbon dioxide in anesthesia, present concepts regarding the harmful effects of increased carbon dioxide tensions,[14] especially in the presence of depression caused by anesthetic agents, make it seem advisable to avoid the use of above normal concentrations of carbon dioxide. It should therefore be necessary to employ a carbon dioxide absorber even with the semiclosed technic.

With total rebreathing technics carbon dioxide absorption is, of course, mandatory. Unfortunately, with the apparatus available carbon dioxide absorption is by no means perfect. Size of canister, constructional features that increase dead space, and other factors tend to decrease the efficiency of absorption. There are conflicting reports regarding the efficiency of absorption as measured by the concentration of carbon dioxide in the inspired air. Adriani[15] reported a concentration of 0.01 per cent with a fresh charge of absorbent, while Conroy and Seevers[16] reported that in their study the carbon dioxide concentration in the inspired atmosphere was consistently found to be of the order of 1 per cent. Dripps[17] found elevated arterial carbon dioxide tensions with cyclopropane anesthesia administered by closed carbon dioxide–absorption technic and suggested that physiologic imbalances secondary to the closed technic may be a factor in the production of decreased blood pressure following cyclopropane anesthesia. In view of the findings of Dripps and of Conroy and Seevers, it would seem that carbon dioxide absorption is not completely efficient as practiced at present. Moreover, it has been shown that the symptoms of carbon dioxide retention are often difficult to recognize in the anesthetized patient.[18] Thus it would seem that total rebreathing technics should be used with caution and that supplementary measures for elimination of carbon dioxide, such as assisted respiration or a change to semiclosed technic, be instituted when indicated.

14. Gray, John S.: *Pulmonary Ventilation and Its Physiological Regulation* (Springfield, Ill.: Charles C Thomas, 1950) p. 33.

15. Adriani, John: *The Chemistry of Anesthesia* (Springfield, Ill.: Charles C Thomas, 1946) p. 92.

16. Conroy, W. Allen, and Seevers, M. H.: Studies in carbon dioxide absorption. Anesthesiology 4:160-173, March 1943.

17. Dripps, Robert D.: The immediate decrease in blood pressure seen at the conclusion of cyclopropane anesthesia: "Cyclopropane Shock." Anesthesiology 8:15-35, Jan. 1947.

18. Mousel, L.; Weiss, W., and Gilliom, L.: A clinical study of carbon dioxide absorption during anesthesia. Anesthesiology 7:375-398, July 1946.

Resistance and Rebreathing

A fourth problem encountered in inhalation technics is that of resistance. Just as the term "dead space" needs careful definition when used in connection with anesthetic technics, so does this term "resistance." Resistance can be defined in abstruse physical terms, but from the standpoint of anesthesia it would probably be more descriptive to define it as any factor that impedes the free flow of gases during the inspiratory phase and/or expiratory phase of respiration. In judging factors that tend to increase resistance, it is essential to distinguish between those that produce inspiratory resistance and those that produce expiratory resistance.

The relation between the amount of rebreathing and the degree of resistance is probably not a direct one, as is the relation between the amount of rebreathing and the anesthetic and carbon dioxide concentrations, nor is it an inverse relation similar to that between the amount of rebreathing and oxygen concentrations. As the amount of rebreathing increases from none at all to total rebreathing, it is obvious that certain constructional features of the apparatus required for partial and total rebreathing technics will impose a certain amount of resistance to respiration. However, in the open technics in which high total flow rates of gases are administered the pressure of these gases must offer some degree of resistance to expiration even when an exhalation valve is placed close to the patient's respiratory tract. Probably even the so-called open drop technic is not completely innocent in this respect, since the inspired air must pass through several thicknesses of gauze.

Classification of Inhalation Technics According to Amount of Rebreathing

Because rebreathing tends to accentuate the problems of maintaining adequate oxygenation and of maintaining normal carbon dioxide concentrations, it would seem that the various problems presented by increasing amounts of rebreathing would be more clearly delineated if the inhalation technics were classified according to the amount of rebreathing employed rather than according to the types of apparatus or the site of entrance of the anesthetic into the respiratory tract. A classification of inhalation technics on the basis of the amount of rebreathing would concentrate attention on the physiologic effects of the various technics and on the physical principles by which the technics operate. Emphasis on these principles might also tend to clarify some of the problems imposed by the factor of resistance.

A classification of inhalation technics according to the amount of rebreathing would, of course, be determined by the two factors which influence the amount of rebreathing, viz., the total flow rate of gases delivered into the respiratory tract and the extent of increase in dead space imposed by the anesthetic apparatus. Taking these two factors into consideration, inhalation technics can be classified in three categories, open, semiclosed, and closed. Obviously, it is difficult to place technics in general use at the present time accurately in the

open and semiclosed categories because of the present limited knowledge of such factors as the interrelationship between flow rates, extent of increase in dead space, and tidal volume. With this fact in mind, the following classification of the inhalation technics is possible.

Open technic.—An open technic is one in which no rebreathing is employed. This classification could include technics in which gases are administered at a total flow rate equal to, or greater than, the respiratory minute volume, e.g., the administration of nitrous oxide and oxygen at a total flow rate of 10 L. or more to an average adult. In the light of the report of Molyneux and Pask[19] that flow rates in excess of minute volume are required to prevent rebreathing, technics in which gases are administered at a flow rate estimated to be equal to minute volume may not belong in this category if a face mask is used. However, since such a technic is at least as open as the so-called open drop technic, one could probably be justified in calling it an open technic—at least until studies have been reported of the carbon dioxide concentrations in the inspired atmosphere with the technic.

This classification would also include technics in which gases may be administered at flow rates less than the respiratory minute volume but in which there is no increase in dead space. The technic now called oral or pharyngeal insufflation would fall into this category. The term "insufflation" is probably superfluous; if it seems desirable to denote a technic in which ether is vaporized by air or oxygen rather than by an anesthetic gas, the expression "ether-air" or "ether-oxygen" by open technic is descriptive enough.

Presumably, the so-called open drop technic would also fit into this classification, provided that the mask construction does not unduly increase dead space and provided that the atmosphere within the mask has an adequate concentration of oxygen. If it is considered necessary to designate that a volatile liquid anesthetic has been dropped on the mask, the present terminology may be used, but ether-air or ether-air-oxygen by open technic is adequately descriptive.

It might be advisable, in view of the problems presented by the so-called intratracheal insufflation technic, to add a third specification for open technics, i.e., that the technic offer no increased resistance to expiration.

Semiclosed technic.—A semiclosed technic employs partial rebreathing. This classification includes technics in which gases are administered at flow rates less than respiratory minute volume. Since rebreathing with such technics may range from a very small amount to almost total rebreathing, and since the amount of rebreathing influences anesthetic and oxygen concentrations, it is obvious that in describing such a technic it is necessary to state the flow rates used as well as the percentages of gases used. The semiclosed classification could also include technics in which the apparatus used for the technic increases dead space. The so-called semiopen drop technic could be included in this category, and we

19. Molyneux, L., and Pask, E. H.[11]

(Continued on page 158)

FLAXEDIL, A NEW CURARE-LIKE DRUG

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Quebec†

Griffith[1-2] from Montreal and Cullen[3-4] from Iowa City first used curare in 1942 for the purpose of obtaining muscular relaxation during general anesthesia. Since then much research has been directed towards preparing synthetic curare-like muscle relaxants that would have a more constant amount of active principle with a more reliable source of material and possibly fewer histaminic effects.

Bovet[5] and Halpern,[6] working in the research laboratories of Rhone-Poulenc-Specia in France, investigated the pharmacologic properties of several synthetic curare-like drugs. Finally, the compound 3,697 RP, flaxedil, was selected for clinical study, and the first clinical trial in 127 cases was reported by Hugenard and Boué[7] in 1948. Since that time reports from anesthetists in France, Britain, Canada, and more recently in the United States have accumulated on the trial use of flaxedil.[8-18] The present article is a general review based on the literature to date and on experience with many hundreds of cases at the Hotel Dieu Hospital in Quebec with Drs. Fernando Hudon and André Jaques,[12] and

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9. Wilson, H. B., and Gordon, H. E.: Flaxedil as a curarizing agent in anesthesia. Lancet **2**:504-505, Sept. 17, 1949.
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13. Dripps, R. D., and Sergent, W. F.: Use of a new curarizing agent, dihydro-beta-erythroidine, for the production of muscular relaxation during anesthesia and surgery. Anesthesiology **8**:241-251, May 1947.
14. Wien, R.: The curarising properties of R. P. 3697. Arch. internat. de pharmacodyn. et de thérap. **77**:96-99, July 1, 1948.
15. Poulenc Scientific Department: Personal communication to the author. Documentation nos. 24 and 48.
16. Karp, Mary, and Dechene, J. P.: RO, 3198. A preliminary report. Unpublished data.
17. Doughty, A. C., and Wylie, W. D.: Section of anesthetics, R. S. M., Jan. 5 and subsequent discussions, 1951.
18. Condon, H. A.: Clinical use of flaxedil. Anaesthesia 6: April 1951.

in Chicago at Wesley Memorial Hospital with Dr. Mary Karp.

Flaxedil is tri-beta-diethylaminoethoxy)-benzene, triethyl iodide. It has a molecular weight of 891 and occurs in pure form as a white, amorphous, odorless, slightly bitter powder. Of interest pharmacologically is its action on the muscular system, respiratory system, circulatory system, and the autonomic nervous system. Flaxedil in adequate dosage relaxes striated muscle in the same manner as curare. At the myoneural junction it interferes with the chemical mediator and thus produces its action in a way similar to that of *d*-tubocurarine chloride, the curare preparation usually used in anesthesia. Its effects are easily and rapidly reversed by neostigmine, prostigmine, or physostigmine, and by RO_2-3198 (tensilon), a new anticurare drug.[16] The order of relaxation is the same as when curare is used: eyelids, jaws, extremities, abdominal muscles, glottis, and, last, the diaphragm. With flaxedil the margin of safety between abdominal relaxation and diaphragmatic paralysis is slightly greater than that found with *d*-tubocurarine chloride.

Vascular tone is not depressed, and the myocardium is unaffected. Bleeding and clotting times are not prolonged. There is ordinarily no decrease in blood pressure even when massive doses are used. On the contrary, an increase in blood pressure may occur either because of surgical stimulation during light anesthesia or because of accumulation of carbon dioxide. Flaxedil causes tachycardia, which, however, seems harmless and self limited. Doughty and Wylie[17] found that this is due to a vagal blocking action. Flaxedil has no effect on the bowel, and vomiting is not induced in man. The appearance of the skin is unaltered, and there is almost a complete absence of any of the histaminic effects that have been reported with the use of curare, such as hypotension, bronchiospasm, and increased secretions.

Clinically, premedication for the use of flaxedil is similar to that for the use of other curare preparations with accent on atropine. Flaxedil can be used to produce muscular relaxation during the light plane of any type of anesthesia, either combined with pentothal sodium or given alone by intravenous injection. The dosage of flaxedil is independent of the weight of the patient but is closely related to his vigor, age, and muscular development. Thus, a young farmer requires larger doses than a sedentary, obese woman. Clinically, 1 to 3 mg. of flaxedil (maximum) per kilogram of body weight is considered the dosage range. If the dosage of flaxedil is compared with that of *d*-tubocurarine chloride, it is found that 15 mg. *d*-tubocurarine chloride is equivalent to 84 mg. flaxedil, or again, 5 cc. *d*-tubocurarine chloride equals approximately 4 cc. flaxedil. We have given up to 400 mg. (20 cc.) flaxedil without untoward reaction.

Muscular relaxation begins sixty to ninety seconds after intravenous injection of flaxedil. Relaxation is complete after four minutes, persists for twenty-five

16. Karp, Mary, and Dechene, J. P.: loc. cit.

17. Doughty, A. C., and Wylie, W. D.: loc. cit.

to thirty minutes, and wears off gradually. Abdominal relaxation with appropriate dosage is perfect, and every surgeon is pleased with the results.

In no case is satisfactory abdominal relaxation achieved without some intercostal paresis. For this reason the last dose should be given at least thirty minutes before the end of the operation. Otherwise, the patient will have inefficient peripheral respiratory activity, and it will be unsafe to send him back to ordinary postoperative ward care.

In certain instances we have had to use an anti-curare drug, but we feel it is best to avoid this routine. An important point that must be remembered with the use of flaxedil, as with all other curare-like drugs, is that the anesthetist must be skilled in the care of the apneic patient and must be capable of performing intratracheal intubation when necessary. This is important because flaxedil is a powerful drug and may produce apnea.

The clinical indications for the use of flaxedil are, in general, the same as those for the use of curare: (1) for abdominal relaxation, (2) for relaxation of large muscle groups in any type of operation, (3) for intubation and endoscopic examination, and (4) to control convulsions during shock treatment and in tetanus.

Flaxedil appears to be the muscle relaxant of choice in intratracheal intubation because it does not produce bronchiospasm and provides excellent relaxation of the muscles of the angle of the jaw, pharynx, and larynx; the cords are also well relaxed. In comparison with the effect of other curare preparations, there is a longer time between intercostal paralysis and loss of diaphragmatic activity.

For patients in shock flaxedil is safer than other curare preparations because with its use there are no decrease in blood pressure due to the drug itself, fewer untoward side effects, and minimal postoperative nausea.

Contraindications to the use of flaxedil are the same as those to the use of curare, i.e., myasthenia gravis and, possibly, asthma, although it would appear to be a safer drug than curare for the asthmatic patient. In addition, it would seem advisable not to use flaxedil or to use it only in small doses in the presence of tachycardia or when tachycardia seems likely to occur under anesthesia, for example, in the patient with hyperthyroidism. Flaxedil may also be considered to be contraindicated for a patient with a poor cardiac reserve because of the possibility of tachycardia. However, we have not observed any untoward effect in such patients that could be attributed to flaxedil. Smaller doses of flaxedil are adequate when ether is the main anesthetic agent.

SUMMARY

It would seem from our own experience that flaxedil is a useful addition to the anesthetist's armamentarium.

ANESTHESIA FOR THORACIC SURGERY

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Detroit

Not long ago a surgeon remarked to me, "When I was a resident at the Massachusetts General Hospital, it was considered a surgical blunder to open the pleura." Why was it a blunder? The lung collapsed rapidly, stimulating inspiratory efforts through the Hering-Breuer reflex. Blood going to the collapsed lung was no longer oxygenated, and carbon dioxide was not given off. The resulting hypoxia and hypercapnia stimulated the carotid chemoreceptors and the respiratory center. Respiratory efforts then became so active that gases from the functioning lung were forced into the collapsed lung and then withdrawn with inspiration. Hypoxia rapidly increased with its deleterious effects upon the heart and circulation.

To-day the surgeon deliberately opens the pleura for operations upon the lungs, heart, mediastinum, and the viscera of the upper abdomen and inadvertently during dissection of the neck, thoracoplasty, lumbar sympathectomy, vagotomy, and so forth. This has only been possible because of the anesthetist's ability to overcome the problems presented by these cases.[1] In no branch of surgery is co-operation between surgeon and anesthetist so necessary.[2]

PHYSICAL STATUS

First we have the problem of the patient's physical status. Among patients undergoing thoracic operations we find cases of advanced tuberculosis, long standing bronchiectasis, lung abscess, carcinoma of the lung and esophagus, congenital heart disease, and mitral stenosis. These are all chronically ill persons with a lowered vital capacity, usually anemia, with depleted blood proteins, and often greatly increased bronchial secretions. They must be properly prepared by blood transfusions, postural drainage, and antibiotics to reduce infections and secretions to a minimum. However, they should not undergo bronchoscopy immediately before operation, as this procedure stimulates the cough reflex and may start bleeding.

SURGICAL REQUIREMENTS

Now consider the surgeon. He may demand the use of the cautery and various electrical lights that are not sparkproof. This will necessitate the use of a nonexplosive agent. He decides upon the position of the patient. Most

Read before the Tri-State Assembly of Nurse Anesthetists, Chicago, May 1, 1951.

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2. Strieder, J. W.: Anesthesia from the viewpoint of the thoracic surgeon. Anesthesiology 11:60-64, Jan. 1950.

surgeons appear to prefer the lateral position. This splints the lung that will have to carry on respiration. It also allows secretions from the diseased lung to gravitate into the good lung. Some will add the insult of the steep Trendelenburg position, which allows the weight of the abdominal viscera to splint the diaphragm, and any excess secretions may gravitate into the upper lobe bronchus. Sandbags to the chest or abdomen should not be permitted.

The prone position recommended by Overholt embarrasses respiration the least and facilitates the aspiration of secretions. It can be carried out on a standard operating table by putting a pillow over the kidney lift and raising the patient's hips four or five inches. Sandbags are then placed under each shoulder. The arm on the operative side is allowed to hang over the edge of the table so as to pull the scapula forward, and the forearm is supported in a sling. The opposite arm is extended in front of the patient on an armboard.

AIM OF THE ANESTHETIST

The anesthetist's aims are:

1. A smooth induction and maintenance of an adequate plane of anesthesia.
2. Rapid recovery after the operation to enable the patient to cough and expectorate secretions from the lower bronchi as soon as possible.
3. Maintenance of a patent airway and provision for an adequate respiratory exchange—not only the administration of sufficient oxygen but the elimination of carbon dioxide.
4. Maintenance of adequate circulation, especially if massive hemorrhage occurs.
5. Prevention or control of injurious reflex activity.
6. Re-expansion of collapsed lung before closure of the chest.

There are differences of opinion as to how these objectives can best be reached.[3-9] I shall outline a method I have found satisfactory. However, the anesthetist's skill is still more important than the agent.

PREMEDICATION

The patient should be awake and active for two hours prior to the operation. This allows time for postural drainage and expectoration of secretions that have accumulated during the night. Premedication is given intravenously in the operating room and never exceeds morphine sulfate, gr. 1/6, with either atropine or scopolamine, gr. 1/150. I prefer atropine, as I found patients more apt to have emergence delirium when scopolamine was used. An 18 gage short bevel needle and a 2 cc. syringe are used to administer the pre-

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8. Mackersie, W. G.: Penthothal sodium with procaine for thoracic surgery. Anesth. & Analg. **28**:213-218, July-Aug. 1949.

9. Sadove, M. S., and Balagot, R.: Anesthesia for gastroesophageal surgery. S. Clin. North America 55-69, Feb. 1951.

medication into a vein in the hand or arm. A 20 cc. Luer-Lok syringe, containing a 2 or 2½ per cent solution of pentothal sodium and with a three-way stopcock, is connected to the needle by a 15 inch length of narrow bore, rubber tubing and securely fastened with adhesive tape. Induction of anesthesia is almost immediately started. If the patient is nervous or apprehensive, induction may be carried out at his bedside. Premedication given an hour or more before operation depresses the cough reflex and allows secretions to accumulate. The presence of secretions in the nasopharynx may precipitate laryngospasm during induction with pentothal sodium.

COURSE OF ANESTHESIA

When the patient has lost consciousness, *d*-tubocurarine chloride is given with a 5 cc. syringe through the free arm of the three-way stopcock, 1 cc. at a time, for a total of 3 to 5 cc., depending on the size of the patient. Anesthesia is deepened to surgical anesthesia. It may be necessary to support respiratory movements by the use of oxygen and pressure on the rebreathing bag of a gas machine. At least three minutes should elapse from the time of giving *d*-tubocurarine chloride before attempting the next step, intubation. Transoral intubation is an absolute necessity. It reduces the dead space from 150 cc. to 50 cc. It allows the anesthetist full control of respiration and a means of aspirating blood or excess secretions from the bronchi.

Intubation should be done with gentleness.[9-12] Most difficulties arise from too light anesthesia, incorrect positioning of the head, or introduction of the blade of the laryngoscope too far. It should be remembered that curare will relax the esophagus, and one may sometimes mistake it for the glottis. The upper teeth should be protected with a piece of gauze and under no consideration should they be used as a fulcrum. Should a tooth be accidentally chipped or broken, it will become enmeshed in the gauze. Under pentothal sodium anesthesia the cords will be seen only as a narrow slit that opens slightly on expiration. They are sprayed with a 10 per cent solution of cocaine through the blade of the laryngoscope, and in a few seconds they will be seen to open more widely. Only about ½ cc. cocaine solution is required. I use a Miller blade and introduce the intratracheal tube on a stilet from the side, thus keeping the cords under direct vision. The tip of the intratracheal tube is introduced until it is within ¼ inch of the cords. As the cords separate on expiration, the tube is passed. One should be careful that the tip of the stilet is at least ½ inch within the intratracheal tube. Force should never be used. A tube should not be longer than 10 inches, otherwise it may get pushed into the right bronchus. The internal diameter of the connector should be as large as the diameter of the tube. The

9. Sadove, M. S., and Balagot, R.: loc. cit.
10. Gillespie, N. A.: *Endotracheal Anaesthesia*. ed. 2 (Madison, Wis.: University of Wisconsin Press, 1948).
11. Sadove, M. S., and Cassels, W. H.: Endotracheal anesthesia. Arch. Surg. **55**:493-497, 1947.
12. Mason, E. B., and Bruner, H. D.: The scientific aspect of endotracheal tubes. Anesthesiology **11**:313-320, May 1950.

largest tube that can be easily introduced should be used. The larger the tube, the less resistance there will be to the flow of gases. Beecher[13] favored tubes smaller than 34 French as being the least traumatic. The glottic opening is approximately the same size as the external nares, so one may get a good idea of the size of the tube required simply by looking at the patient's nose. I use inflatable cuffs rather than throat packs. We make our own cuffs from Penrose drains and finger cots and use a no. 7 urethral catheter for inflation.[14] Tubes are lubricated with an anesthetic ointment or jelly, and once they are in place, it is seldom necessary to inflate the cuff. The ointment on the cuff appears to adhere to the surface of the trachea and will withstand a pressure up to 15 to 20 mm. Hg without leaking, thus serving as a safety factor in preventing excessive intrapulmonary pressures. At the same time there is no positive pressure on the tracheal mucosa. The intratracheal tube is then connected to a gas machine supplying a 50-50 per cent mixture of nitrous oxide and oxygen, and the patient placed in position for operation.

The use of procaine hydrochloride intravenously as an adjunct to anesthesia is a highly controversial matter.[8-15] I have used it in both a ½ per cent and a 1 per cent solution in more than a thousand cases and have made the following clinical observations: (1) It reduces by 20 per cent the amount of anesthetic agent required. (2) There are fewer reflexes activated by stripping the ribs, opening the pleura, or dissecting the hilus of the lung. (3) It decreases the incidence of cardiac irregularities. (4) It causes a slight decrease in blood pressure and if given in excess a very severe decrease. There is usually a slight slowing of the pulse rate, but there may also be an increase in rate. (5) The skin is dry and warm. (6) There is an atropine-like effect on salivary and bronchial secretions. (7) Procaine passes into traumatized tissue to give a degree of local anesthesia and pain relief that may last from one-half hour to five hours after operation. Patients are usually comfortable on regaining consciousness and will co-operate with the nurse.

Since procaine depresses cardiac musculature, it should be used cautiously in elderly patients, especially those with severe hypertension. It is to be avoided in patients who have a history of sensitivity to procaine. Cardiac arrest can occur before respiratory failure; therefore, the blood pressure must be checked frequently and a finger kept on the pulse at all times. Blood pressure will return to its previous level within five minutes after the administration of procaine solution has been discontinued. Not more than 40 mg. per minute should be given at any time. Usually, about one half that amount is sufficient, i.e., about 60 drops of a ½ per cent solution

13. Beecher, H. K.: A note on the optimal size of endotracheal tubes based upon studies of blood gases. Anesthesiology 11:730-732, Nov. 1950.

14. Whitehouse, S.; Seldon, T. H., and Peterson, J. R.: How to make an inflatable cuff for an endotracheal tube. Anesthesiology 11:120-124, Jan. 1950.

8. Mackersie, W. G.: loc. cit.

15. Taylor, I. B.; Stearns, A. B.; Kurtz, H. C.; Henderson, J. B.; Sigler, L. E., and Nolte, E. C.: Intravenous procaine—an adjuvant to general anesthesia: A preliminary report. Anesthesiology 11:185-198, March 1950.

per minute. Less is required after the first hour. We prepare our procaine solution by dissolving 5 Gm. in 1,000 cc. of 5 per cent dextrose in distilled water. A flask containing this solution is connected to the spare arm of the three-way stopcock and allowed to run continuously throughout the operation.

Administration of blood is immediately started with a 15 or 16 gage needle in a convenient vein. Once the patient is anesthetized, there is seldom any difficulty in finding a large vein in the forearm or hand. Provision should also be made for the application of pressure to the bottle of blood as hemorrhage may be excessive, and unless blood is quickly replaced, the patient may not survive. If pressure is used, blood can be replaced at a rate of 100 cc. per minute through a 15 gage needle.[16] If necessary, one may also use the 18 gage needle, connected to the syringe for pentothal sodium, for a second bottle. At least 2,500 cc. blood should be immediately available at the start of the operation. One should attempt only to replace blood lost. Overloading the circulation may precipitate pulmonary edema, especally if one or more lobes of the lung have been removed.

Anesthesia may be maintained with pentothal sodium provided one does not exceed 1 Gm. per 100 pounds body weight. More than this will cause postoperative depression and delay recovery.

Once the surgeon has opened the pleura, he is unlikely to require the cautery, and ether may be added to the mixture; 30 to 40 cc. of ether will usually be sufficient. Ether should be added slowly. Deep anesthesia is not required.

With the opening of the pleura, the lung will collapse rapidly. This stimulates the Hering-Breuer reflex. A little pressure should be kept on the rebreathing bag so that the lung collapses slowly. There will be less reflex disturbance of respiration.

If the patient has extensive inflammatory disease, the mediastinum will be fixed, and respiration will be carried on satisfactorily by the remaining lung. However, if the mediastinum is not fixed, it will shift to the opposite side, and the respiratory exchange will be insufficient. "Bucking" then occurs. This consists of respiratory efforts forcing gases from the functioning lung into the collapsed lung on expiration and aspirating them on inspiration. At the same time the mediastinum swings from side to side. If this condition is allowed to persist, the patient rapidly goes into shock. Should this occur, it can be controlled in a few seconds by giving 100 mg. pentothal sodium and 1½ cc. d-tubocurarine chloride. This so depresses all respiratory movements that the anesthetist can readily carry on artificial respiration by rhythmically compressing the rebreathing bag and releasing all pressure during the expiratory phase. The necessity for these measures can to a large extent be avoided if anesthesia is sufficiently deep and the anesthetist assists each respiratory effort by gentle pressure on the bag—from 5 to 10 mm. Hg. This is known as assisted or complemen-

16. Coppedge, W. T., and Ochsner, A. J.: Improved method for rapid replacement of blood. Anesthesiology 10:645-646, Sept. 1949.

tal respiration.[17]

Usually the movement of the diaphragm does not disturb the surgeon, but should he want a perfectly quiet diaphragm, the technic of controlled respiration is employed. This requires (1) depression of the respiratory center, (2) depression of the Hering-Breuer reflex by rhythmically overinflating the lung, and (3) blowing off excess carbon dioxide. The anesthetist assists each respiration until the patient reaches a state of apnea and then carries on artificial respiration. Curare may be helpful in this situation.[18]

A third type of respiration is usually employed during closure of the chest, i.e., respiration against positive pressure.[19] The lung is inflated by positive pressure of 15 to 20 mm. Hg, and while the chest is being closed, a pressure of 8 to 10 mm. Hg is maintained during expiration in order to keep the lung expanded.

Throughout the operation it is important that any lung that is to be left should be inflated every twenty minutes. However, the surgeon's permission should always be asked. It is also necessary that the anesthetist have a good view of the open chest while exerting any pressure on the rebreathing bag.

While the patient is breathing under positive pressure, a rather severe decrease in blood pressure may occur. The increased intrapulmonary pressure collapses the veins and capillaries of the alveoli so that less blood passes through them and less blood reaches the heart. This situation quickly corrects itself once the patient is breathing normally. The same situation arises each time the lung is expanded.

When the closure of the chest is begun, it is seldom necessary to administer more pentothal sodium, and the ether concentration may be lowered by emptying the bag several times and by maintaining anesthesia with an open flow once the closure of the chest is tight. Should the patient appear to feel the skin suture, the concentration of nitrous oxide is stepped up to 70 per cent, and the administration of procaine solution may be increased to the maximum for a few minutes.

Upon conclusion of the operation the patient's nasopharynx is carefully aspirated; the aspirating catheter is then passed down the intratracheal catheter, and the trachea and bronchi are aspirated as thoroughly as possible. The intratracheal catheter is withdrawn while the aspirating catheter is still within the lumen. The aspirating catheter should be at least 6 inches longer than a urethral catheter and have two or three holes in the terminal 2 inches. A suitable length of no. 14 Levine tube serves very well. Usually, the patient will regain consciousness within twenty minutes. Bronchoscopy is left to the discretion of the surgeon.

Needless to say, one should listen to the patient's breathing throughout the operation, and secretions should be aspirated as they collect. The pulse should

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17. Watrous, W. G.; Davis, F. E., and Anderson, B. M.: Manually assisted and controlled respiration: Its use during inhalation anesthesia for the maintenance of a near-normal physiologic state — a review. Anesthesiology 11:538-561, Sept. 1950; Anesthesiology 11:661-685, Nov. 1950.

18. Harroun, P., and Hathaway, H. R.: The use of curare in anesthesia for thoracic surgery. Surg., Gynec. & Obst. 82:229-231, Feb. 1946.

19. Saunders, P.: Management of positive pressure in endotracheal anesthesia. Anesthesiology 10:743-752, Nov. 1949.

also be continuously palpated, especially during traction on the hilus of the lung. The surgeon should be notified of any irregularities occurring during dissections around the hilus and asked to inject the area with 1 per cent procaine.[20]

Should the patient appear to require an unusual amount of anesthetic, the intravenous injection of one-half the preanesthetic dose of morphine will prove advantageous.

Care must be taken not to exceed a pressure of 20 mm. Hg on the rebreathing bag, as excessive pressure may rupture alveoli or cause leaks through the connective tissue of the bronchioles, penetrate the mediastinum, and produce interstitial emphysema.[21]

Cardiac irregularities of auricular origin are seldom serious, but ventricular extrasystoles may rapidly lead to ventricular tachycardia and fibrillation.

Much the same technic has been used for thoracoplasty except that the trachea is not usually intubated unless a lengthy procedure is anticipated. If the trachea is not intubated, one must be careful in using pressure on the rebreathing bag, especially if curare has been used. The esophagus may be relaxed and the stomach easily inflated.

Infants and children present other problems. No satisfactory method has been devised that uses the standard gas machine. Intratracheal tubes must be thin walled but still not kink easily. A size of tube that fits should be used without a cuff. Maintenance of anesthesia is best carried out with ether. I prefer Ayres' technic. Oxygen is bubbled through ether. If it is necessary to assist respirations, this can easily be done by alternately closing and opening the free arm of the Y piece with a finger. The finger movements should be synchronized with the patient's respiratory efforts by closing the Y piece on inspiration and releasing it on expiration. The anesthetist must have a good view of the operative field at all times. The respiratory exchange can be readily followed with a stethoscope by placing the chestpiece just in front of the open arm of the Y.

One can only learn to administer good anesthesia for thoracic operations by administering it. However, one can practice the controlled respiration technic during gallbladder operations when the surgeon is dissecting out the cystic duct and artery. He will appreciate a quiet abdomen. Experience with complemental respiration may be gained during pentothal sodium-curare inductions when the respirations are so frequently depressed.

SUMMARY

Opening the pleura disturbs the mechanics of respiration. The anesthetist must: (1) maintain a suitable depth of anesthesia; (2) provide a satisfactory airway with an adequate exchange of oxygen and carbon dioxide; (3) aspirate any secretions that may be present; (4) inflate the lung before closure of the chest; (5) replace any blood lost; and (6) prevent reflex activity that may be harmful to the patient.

20. Harken, D. E., and Norman, L. R.: The control of cardiac arrhythmia during surgery. Anesthesiology 11:321-327, May 1950.

21. Fenn, W. O.: Mechanics of respiration. Am. J. M. Sc. 10:77, Jan. 1951.

OBSERVATIONS ON ANESTHESIA FROM AN ORTHOPEDIC STANDPOINT

Donald W. Hedrick, M.D., F.A.C.S.
Tampa, Fla.

During my undergraduate days at the University of Michigan the importance of fluids was repeatedly emphasized by Drs. Newberg and Coller. Their efforts finally resulted in many published works on the importance of water balance and hydration in surgical as well as medical problems. To the surgeon the importance of this factor in preoperative and postoperative states became increasingly apparent and is now generally accepted.

Later at the Henry Ford Hospital Kettering's oxyhemograph, developed by General Motors engineers, was used. It has a photoelectric cell, which is attached to the ear and which accurately records the state of oxygenation during an operation. Many of the cases that formed the basis of the final report were orthopedic cases, because in those days I used pentothal sodium almost exclusively for adults. We found that with proper preoperative and postoperative medication oxygen alone seemed to give better results than a nitrous oxide-oxygen mixture. The studies on cerebral anoxia and anoxemia that grew out of these experiments are now well known to you all. It was noted, for example, that satisfactory oxygenation reached its lowest ebb after the operation was completed and when the anesthesia was terminated. As a result, oxygen was administered in the recovery ward and in the patient's room until his reflexes were active. Because of its depressing effect on respiration, morphine sulfate was replaced by demerol, and finally no medication was given until the patient was reacting well, regardless of how restless and confused he might be.

Children present many special problems for the orthopedic surgeon as well as for the anesthetist. These problems may be roughly divided into four groups:

1. **Acute fractures.**—Acute fractures may occur at any time and are best treated without delay. Many youngsters will have eaten recently or perhaps have had something to drink; this in itself presents a problem to the anesthetist. The problem of aspiration during anesthesia is ever present. It is increasingly difficult to maintain anesthesia at a proper level, and often, in spite of the most skilful handling, reflex activity will occur in the middle of a procedure. Moderate relaxation is needed for the reduction of a fracture, and this relaxation must be maintained until the cast is well set. Too often the anesthesia is lightened when the cast is being applied and reflex activity

Read before the Fourteenth Annual Meeting of the Southeastern Assembly of Nurse Anesthetists, St. Petersburg, Fla., April 5, 1951.

occurs. As a result the reduction is lost, and one must start all over.

2. **Elective surgery.**—In general, orthopedic operations require a light plane of anesthesia. It goes without saying that blood loss and blood replacement are items to be considered, and if a major procedure is at hand, all arrangements should be made ahead of time. The same is true with the state of hydration of the patient. If the operating room is too warm or the drapes too heavy, fluids are lost, and the patient's condition suffers as a result. In addition, a tourniquet is used in many procedures on the extremities, and if a major blood vessel has been severed, hemorrhage and shock may follow release of the tourniquet. The state of the circulation must be watched carefully until the patient's reflexes are completely active. If a cast is applied, special attention must be given to the digits in order to avoid recognition of dangerous swelling too late.

3. **Hazards to be avoided.**—Not infrequently the airway may be blocked by tonsil tissue or adenoids to interfere with respiration, anesthesia, and oxygenation. Material in the mouth, such as gum, is occasionally seen and may possibly cause trouble if not discovered and removed.

It should be noted that an infant has a relatively small trachea, and in an infant, especially, secretions may be a problem, and aspiration may be necessary. Suction should always be available to remove the secretions. Scopolamine administered preoperatively to youngsters 3 years of age or older is a far better agent for drying secretions than atropine. During a surgical procedure there may be quite a variation in the patient's temperature due to the varying state of hydration caused by heavy drapes, high humidity in the operating room, or the administration of excessive doses of atropine or scopolamine. The possibility of emesis is always present, and one should be ready to perform aspiration for this reason also. In the event circulatory collapse develops and it is impossible to insert a needle into the small vein, the tibia or sternum can always be used for fluid replacement.

4. **Choice of anesthesia.**—I think it is generally considered that open drop ether is still the safest agent for young children. Cyclopropane is also satisfactory if motor saws, hammers, or osteotomes are not being employed. Anesthesia for many youngsters with fractures who are treated as out-patients can be maintained with nitrous oxide-oxygen and ether, particularly in the fluoroscopic room, if the administration is carefully carried out. Barbiturates are not recommended for youngsters. For elective operations it is often advisable to produce basal anesthesia with pentothal sodium or avertin to allay apprehension. The dosage is kept small enough so that it may be used with safety, and I think it is psychologically sound.

I would also like to emphasize the hazard of barbiturate anesthesia for the aged. Barbiturate anesthesia may well result in anoxia, as may the use of nitrous oxide. It is advisable, I repeat, to have oxygen in the recovery room, and to give it in the patient's room when barbiturates or nitrous oxide is used. Niacin in daily doses is quite helpful when

anoxia develops in spite of everything. The condition is usually assigned to severe cerebral arteriosclerosis and inadequate blood supply and, therefore, inadequate oxygenation. This ever present possibility must be kept in mind by both the surgeon and the anesthetist when surgery is undertaken on elderly persons.

INHALATION TECHNICS

(Continued from page 145)

could thus be conveniently rid of the need to try to explain the difference between partially open and partially closed.

Closed technic.—This technic employs total rebreathing. This classification includes, of course, the closed carbon dioxide–absorption technics and, unfortunately, certain closed technics in which carbon dioxide absorption is not used.

Admittedly, such a classification may not be all embracing, and it would not be vividly descriptive of our many beloved gadgets. But it could, by helping to clear our terminology of semantic encumbrances inherited from the past, and by emphasizing physiologic and physical principles, help to focus attention on the important aspect of inhalation technics, and that is what the technic of administration does to a patient's physiologic processes. Concentration of attention on this aspect may increase our awareness of the limitations of our present technics and may lead to improvements in these technics and possibly to an even sounder basis for the classification of inhalation technics.

SUMMARY

It has been pointed out that the present classifications of inhalation technics do not properly emphasize the basic physical and physiologic principles underlying technic of administration. It is suggested that all inhalation technics be classified according to the amount of rebreathing permitted, because such a basis for classification emphasizes the physiologic aspects of anesthesia. The effects of rebreathing on anesthetic, oxygen, and carbon dioxide concentrations are discussed, and a reclassification of inhalation technics is suggested.

PEDIATRIC ANESTHESIA

(Continued from page 132)

the anesthetist. But the conscientious surgeon must strive to preserve his equanimity and good manners not only for their own sake but also because good judgment in emergency is impossible if he lets himself get out of hand.

6. To remember always that his anesthetist is to him as his left hand is to his right. If he cannot co-ordinate them smoothly, he does not deserve the name of surgeon.

SUMMARY

Let me say that six times in my own life I have undergone general anesthesias at the hands of nurse anesthetists, and I have no cause to regret any of them. Four of the six were within the range of vivid memory, and I always felt that I was in safe and competent hands. We have worked with nurse anesthetists in this clinic for a good many years, and the relationship has been a happy one for me and, I hope, for them. The remarks I have made about the professional qualifications for competent pediatric anesthesia are based on my observations of our own nurse anesthetists. They are a credit to their profession, and we are very proud of them.

NOTES

CASE REPORTS are the foundation of the medical literature. Their brevity makes them interesting to write and assures their being read. There is a place in this section of NOTES for case reports as well as for descriptions of gadgets and special technics. Send in your contribubtion now. Other anesthetists will be helped by it.

INTRATRACHEAL INTUBATION IN SEVERE TRAUMA

John G. Meyer, Jr., M.D., Robert M. Booth, D.D.S., and Sister Rudolpha, R.N.*
Springfield, Ill.

The first two considerations of any severe accident in the emergency room of a general hospital are shock and, with it, cerebral suboxygenation. The early treatment of these combined conditions lessens the major effects of other manifestations of trauma, such as fracture, lacerations, and internal injuries. One of the major considerations in such a situation is maintaining an airway for the patient to provide sufficient oxygenation of blood to combat shock and keep the respiratory mechanism operating. The following case report gives an example of close co-operation between the anesthesia department and the surgeon in the early and efficient treatment of a severely injured Air Force private to whom oxygen was administered intratracheally to tide him over severe shock.

REPORT OF A CASE

The private was first seen in the emergency room of St. John's Hospital at approximately 2:00 a.m., February 23, 1951, where he had been taken by ambulance after an accident at the northeast edge of the city approximately half an hour before. The Sister in charge advised the surgeon when calling him that the patient would probably not be alive by the time he could get to the hospital, which was about fifteen minutes later.

The patient was hitch-hiking a ride on the right hand side of the pavement during a rain storm when he was struck by an automobile and thrown to the side of the highway, his chin apparently hitting the upright steel post indicating a bus stop for the local transportation company.

When the patient was seen in the emergency room, there was no evidence of alcoholism. He was unconscious and had generalized, unpatterned convulsions. His jaw was displaced, and there was considerable bleeding from his mouth. He was unable to respond to any stimuli.

*St. Johns Hospital.

He was immediately admitted to the hospital. The prognosis was considered grave at the time of admission, and death was expected at any minute.

The anesthesia department was notified by the attending Sister as soon as the patient came in, and at the time the patient was seen by the surgeon, the airway had been aspirated and oxygen already was being administered by nasal catheter. As soon as he was admitted to the hospital, the nasal tube was passed through his nasopharynx into the trachea. He was immediately put on 7 L. oxygen per minute. Blood pressure and pulse rate were taken every hour. His blood pressure on admission was 130 mm. Hg systolic and 100 mm. Hg diastolic and continued that way for approximately three hours, at which time it decreased to 100 mm. Hg systolic and 76 mm. Hg diastolic. He was given several blood transfusions, but the blood pressure continued to decrease to as low as 80 mm. Hg systolic and 56 mm. Hg diastolic with a pulse rate of 130 to 140 a minute. His blood pressure slowly responded to the administration of blood and by the second day was at a fairly normal level. His convulsions were controlled fairly well by the intramuscular injection of phenobarbital sodium, gr. 1½, and intravenous injections of 50 cc. of 50 per cent glucose solution.

Because of a bad displacement of the jaw, with six fractures in the mandible and four in the maxilla, causing a lack of support, the tongue fell back and filled the pharynx. A dental surgeon was consulted, and he felt that it was immediately necessary to wire several of the anterior fragments of the mandible to the maxilla. This was done without any anesthesia, the patient remaining unconscious throughout the procedure; on completion of the operation breathing was immediately easier (figure).

Diagram illustrating the muscle bridge of the neck, attaching from the mandible to the sternum. Embarrassment of the airway is the result of loss of support of the muscle bridge in fractures of the mandible.

His condition was too serious for roentgenograms to be made, and these were not made until a much later date. At that time no fractures of the skull were seen, but the fractures of the maxilla and mandible were confirmed. It was also noted that,

after an airway was established and bleeding from the mouth was minimized, he had several lacerations of the face, which it was not thought advisable to suture. These were packed open for secondary wound healing. Examination of the skull showed no definite palpable depressions, and the cranial nerves were found to be intact. There was no blood seen in the ears and no rigidity of the neck. The patient moved all four limbs during his convulsions, and his reflexes were found to be good. The Babinski sign and clonus were noted for the first twenty-four hours only. Temperature on admission to the hospital was 105 F. On the second hospital day it had decreased to 101 F. but continued between that and 103 F., slowly tapering off on the ninth hospital day. His respiratory rate on admission was 50 a minute and became stabilized on the fifth day to between 20 and 30 a minute. Prognosis on the day of admission was very doubtful, but since he stayed alive the first twenty-four hours, hope was increased. Urine examination on the day of admission showed some red cells, and Foley catheter drainage was instituted. Urine examination showed no abnormal findings on the second hospital day.

His general condition remained somewhat improved over the course of the next several days. He was fed intravenously, and his condition was followed very closely by laboratory studies.

The nasal intratracheal airway was removed after thirty-six hours to prevent ulceration and scarring of the nasal passages. Breathing progressed somewhat slowly but satisfactorily with the administration of oxygen by nasal catheter after initial temporary wiring of the jaw. On the third hospital day a more complete wiring of the jaws was done by means of Jelenko splints.

On the ninth hospital day the patient began to show some signs of consciousness, but it was not until two or three days later that he was able to respond to questions, although he could not give fine responses and was unable to use his hands for anything but gross movements. At this time pulmonary ventilation was satisfactory without oxygen therapy, and the administration of oxygen was stopped. During the nine days the patient had the constant attention of someone from the anesthesia department to see that his airway was patent and oxygenation maintained.

On the fourteenth hospital day he was well enough to be transferred to an Air Force hospital, but he was not able to remember anything until after the end of the fifth week of hospitalization.

When he was seen approximately eight weeks after leaving the hospital on a return visit to this community, he appeared to be in fairly good condition. His mentality appeared as good as ever according to his fiancée who accompanied him, although he had some difficulty in talking because of residuals of the jaw fractures.

SUMMARY

A case of severe trauma, secondary to an automobile injury, is reported and illustrates the benefit of co-operation among the anesthesia department of a

(Continued on page 162)

LEGISLATION

Emanuel L. Hayt, LL.B.*

PHYSICIAN MUST EXPLAIN PRESENCE OF FOREIGN OBJECT LEFT IN PATIENT'S BODY AFTER OPERATION.[1]—A physician who was consulted by a patient made a diagnosis of extrauterine pregnancy. He advised her that an immediate abdominal operation was necessary. He operated assisted by another doctor.The patient alleged that immediately following the operation she had severe pains in the abdominal region at about the same place where the physician had made the incision. For two years she suffered extreme and excruciating pain in that part of the body. Following the operation she consulted the physician on several occasions and complained to him of her painful condition. He assured her that the operation had been a complete success and that her suffering was caused by common gas pains. At other dates following the operation the physician diagnosed her malady as anemia and tilted uterus. Various treatments were rendered, but the alleged pain and suffering persisted. She lost about thirty pounds, was unable to eat solid food, could not sleep, vomited frequently, became extremely nervous, and was so physically incapacitated that it was impossible for her to fulfil her duties as a wife and a mother. About two and one-half years after the operation she underwent a second abdominal operation performed by another surgeon. During the performance of this second operation a cloth sack, approximately 10 inches wide by 16 inches or 18 inches long, was removed from her large bowel where it joined the small intestine.

The Court held that the patient was entitled to have the question of the negligence of the physician go to the jury. On the basis of the evidence, it was for the physician to explain how the foreign object could have been left in the abdomen without negligence on his part. It is for the jury to accept or reject the explanation of the physician.

*Counsel for A.A.N.A.

1. Tiller *et vir*, v. Von Pohle, 19 C.C.H. Negligence Cases 500.

INTUBATION FOR TRAUMA

(Continued from page 161)

hospital, the emergency room, and the surgeon.

We believe that if it were not for the ready availability of oxygen and the expeditious insertions of the intranasal airways into the trachea by persons well trained to use these instruments, this patient would have died from anoxemia and shock. It is also possible that without adequate oxygenation the patient would have had some residual mental changes from cerebral damage from hypoxia. Only with close co-operation among all three departments can the immediate mortality and morbidity of severe trauma be reduced and more persons salvaged from the carnage of the machine world.

NOMINATIONS FOR OFFICE
AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

1951-52

At the Eighteenth Annual Meeting in St. Louis, September 17-20, the Nominating Committee will present a ballot of candidates for office that will include the following members who have qualified and have given their consent to serve.

PRESIDENT

Verna E. Bean (Lexington, Ky.): Graduate of St. Elizabeth's Hospital School of Nursing, Boston; graduate of Long Island College Hospital School of Anesthesia, Brooklyn; Army Nurse Corps, three and one-half years; member of A.A.N.A. in good standing since 1933; former president, New York Association of Nurse Anesthetists; member, Board of Trustees, A.A.N.A., 1947-49; 2nd vice president, A.A.N.A., 1949-50; president, A.A.N.A. 1950-51.

1ST VICE PRESIDENT

Josephine Bunch (Shriners' Hospital for Crippled Children, Portland, Ore.): Graduate of Sacred Heart Hospital School of Nursing, Spokane, Wash.; graduate of St. Vincent's Hospital School of Anesthesia, Portland, Ore.; member of A.A.N.A. in good standing since 1936; former president, Oregon Association of Nurse Anesthetists; former chairman, Western States Assembly of Nurse Anesthetists; member, Board of Trustees, A.A.N.A., 1948-50; chairman, Personnel Practices Committee. A.A.N.A.; 1st vice president, A.A.N.A. 1950-51.

2ND VICE PRESIDENT

Minnie V. Haas (St. Joseph's Hospital, Fort Worth, Tex.): Graduate of Methodist Deaconess Hospital School of Nursing, Rapid City, S. Dak.; graduate of Lakeside Hospital School of Anesthesia, Cleveland; member of A.A.N.A. in good standing since 1934; former president, Texas Association of Nurse Anesthetists; member, Board of Trustees, A.A.N.A., 1948-50; 2nd vice president, A.A.N.A., 1950-51.

Betty E. Lank (Children's Hospital, Boston): Graduate of Newton-Wellesley School of Nursing; graduate of Newton-Wellesley Hospital School of Anesthesia; member of A.A.N.A. in good standing since 1937; former president and secretary-treasurer, Massachusetts Association of Nurse Anesthetists; former president and secretary-treasurer, New England Assembly of Nurse Anesthetists; member, Board of Trustees, A.A.N.A., 1949-51.

Marie N. Bader (Colorado Springs, Colorado): Graduate of St. Joseph's Hospital School of Nursing, Philadelphia; graduate of Postgraduate Hospital School of Anesthesia, University of Pennsylvania, Philadelphia; member of A.A.N.A. in good standing since 1939; former vice president, Colorado Association of Nurse Anesthetists; member, Board of Trustees, A.A.N.A., 1946-48; 1st vice president, A.A.N.A., 1949-50.

TREASURER

Agnes M. Lange (Ravenswood Hospital, Chicago): Graduate of Mt. Carmel Hospital School of Nursing, Columbus, Ohio; graduate of St. Joseph's Hospital School of Anesthesia, Chicago; member of A.A.N.A. in good standing since 1935; secretary-treasurer, Indiana Association of Nurse Anesthetists, 1937-50; member, Tri-State Assembly Board of Trustees, 1940-50; treasurer, A.A.N.A., 1950-51.

TRUSTEES

Anne Beddow (Crippled Children's Hospital, Birmingham, Ala.): Graduate of St. Vincent's Hospital School of Nursing, Birmingham; graduate of Lakeside School of Anesthesia, Cleveland; former president, Alabama Association of Nurse Anesthetists; member of A.A.N.A. in good standing since 1931; former president, Southeastern Assembly of Nurse Anesthetists; former president and executive secretary, Alabama State Nurses' Association; chairman, Nominating Committee, A.A.N.A.

Olivia Brye (Portland, Ore.): Graduate of Deaconess Hospital School of Nursing, Grand Forks, N. Dak.; graduate of Lakeside School of Anesthesia, Cleveland; member of A.A.N.A. in good standing since 1934; former president, Oregon Association of Nurse Anesthetists; former vice chairman, Western States Section of Nurse Anesthetists; trustee, Oregon Association of Nurse Anesthetists; editor *Oanagram*.

Jessie L. Compton (Dallas, Tex.): Graduate of Parkland Hospital School of Nursing, Dallas, Tex.: graduate of Baylor University Hospital School of Anesthesia, Dallas, Tex.; member of A.A.N.A. in good standing since 1940; former president, Texas Association of Nurse Anesthetists.

Martha S. Jackson (Municipal Hospital, Tampa, Fla.): Graduate of Macon Hospital School of Nursing, Macon, Ga.; graduate of Long Island College Hospital School of Anesthesia, Brooklyn; member of A.A.N.A. in good standing since 1943; former president, Florida Association of Nurse Anesthetists; chairman, Southeastern Assembly of Nurse Anesthetists; member, Nominating Committee, A.A.N.A.

Madeleine King (Meadville, Pa.): Graduate of Spencer Hospital School of Nursing, Meadville, Pa.,; graduate of Lakeside Hospital School of Anesthesia, Cleveland; member of A.A.N.A. in good standing since 1933; former president, Pennsylvania Association of Nurse Anesthetists.

Helen G. Oulton (Maine General Hospital, Portland, Maine): Graduate of Maine General Hospital School of Nursing; graduate of Maine General Hospital School of Anesthesia; member, A.A.N.A. in good standing since 1947; vice president, Northeastern Assembly of Nurse Anesthetists.

Hattie R. Vickers (Nashville, Tenn.): Graduate of Rawlings Sanitorium School of Nursing, Sandersville, Ga.; graduate of St. Joseph's Hospital School of Anesthesia, Chicago; graduate of Charity Hospital School of Anesthesia, New Orleans; charter member, A.A.N.A.; 1st vice president, A.A.N.A., 1938-39.

Margherita Powers (Johns Hopkins Hospital, Baltimore): Graduate of St. Joseph's Hospital School of Nursing, Savannah, Ga.; graduate of the Johns Hopkins Hospital School of Anesthesia, Baltimore; member of A.A.N.A. in good standing since 1946; member, Examination Committee, A.A.N.A.; president, Maryland Association of Nurse Anesthetists.

Mary Zeig (Veterans Hospital, Fayetteville, Ark.): Graduate of Seton Infirmary School of Nursing, Austin, Tex.; graduate of John Gaston Hospital School of Anesthesia, Memphis; member of A.A.N.A. in good standing since 1942.

EIGHTEENTH ANNUAL CONVENTION
AMERICAN ASSOCIATION OF
NURSE ANESTHETISTS

September 17-20, 1951

ST. LOUIS

Hotel Headquarters—Hotel Lennox

All General Sessions and the Business Session will be held in Kiel Auditorium, Arena Hall

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PROGRAM

Sunday, September 16

10:00 A.M.-6:00 P.M.—**Registration**
A.H.A. Headquarters—Hotel Jefferson

Monday, September 17

8:00 A.M.—**Registration**
Registration Desk—Kiel Auditorium

9:00 A.M.—**Assembly of Directors of Schools of Anesthesia**
Kiel Auditorium, Arena Hall

Progress Report on Accreditation of Schools of Anesthesia

Helen Lamb, R.N.
Director, School of Anesthesia
Barnes Hospital, St. Louis
Presiding Officer

A. R. Gilliland, Ph.D.
Professor of Psychology
Northwestern University, Evanston, Ill.

C. W. Meredith, Ph.D.
Assistant Professor of Education
Northwestern University, Evanston, Ill.

11:00 A.M.— **Council Session**

Kiel Auditorium, Arena Hall
Florence A. McQuillen, R.N.
Executive Director, A.A.N.A.
Presiding Officer

2:00 P.M.— **General Session**

Kiel Auditorium, Arena Hall
Verna E. Bean, R.N.
President, A.A.N.A.
Presiding Officer

Invocation

Sister Mary Borromea, R.N.
St. Francis Hospital
Peoria, Ill.

Address of Welcome

Verna E. Bean, R.N.
President, A.A.N.A.

Address of Welcome from A.H.A.

Anthony J. J. Rourke, M.D.
President-elect, A.H.A.
Stanford University Hospital
San Francisco, Calif.

2:30 P.M.— Dean Eberhardt, R.N.
Past President, Missouri Association of Nurse Anesthetists
Presiding Officer

Plan for Nursing Organizations

Louise Knapp, R.N.
Director of Nursing
Washington University, St. Louis

Forum: Anesthesia as a Nursing Function

Myra Van Arsdale, R.N.
St. John's Hospital, Cleveland
Moderator

Frank R. Bradley, M.D.
Director
Barnes Hospital, St. Louis

Emanuel Hayt, LL.B.
New York City

August H. Groeschel, M.D.
Assistant Director
New York Hospital, New York City

Louise Knapp, R.N.
Director of Nursing
Washington University, St. Louis

John S. Lundy, M.D.
Head, Section on Anesthesiology
Mayo Clinic, Rochester, Minn.

Frank Walton, M.D.
Assistant Professor of Clinical Surgery
Washington University, St. Louis

6:00 P.M.—**Southern States Dinner**
Daniel Boone Room
Statler Hotel

Tuesday, September 18

9:00 A.M.— **Business Session**

Kiel Auditorium, Arena Hall
Verna E. Bean, R.N.
President, A.A.N.A.
Presiding Officer

Call to Order
Reading of Minutes
Reports of Officers
Report of Nominating Committee

11:00 A.M.—**Election of Officers**

2:00 P.M.— **Business Session**

Kiel Auditorium, Arena Hall
Verna E. Bean, R.N.
President, A.A.N.A.
Presiding Officer

Reports of Standing Committees
Reports of Special Committees
Unfinished Business
New Business

Wednesday, September 19

Clinics

Barnes Hospital
Jewish Hospital
St. John's Hospital
Missouri Baptist Hospital
De Paul Hospital
St. Louis City Hospital
Firmin Desloge Hospital

2:00 P.M.— **General Session**

Kiel Auditorium, Arena Hall

Thelma A. Wilson, R.N.
President, Kansas Association of Nurse Anesthetists
Presiding Officer

Carbon Dioxide in Anesthesia—Dangers of Usage—Advantages and Disadvantages
Stuart C. Cullen, M.D.
Professor of Surgery
University of Iowa College of Medicine, Iowa City

3:00 P.M.—**Forum: Evaluation of Surgical Patient for Anesthesia**

D. W. Eastwood, M.D.
Anesthesiologist
Barnes Hospital, St. Louis

Morton D. Pareira, M.D.
Surgeon
Jewish Hospital, St. Louis

Burton A. Shatz, M.D.
Instructor in Medicine
Washington University Medical School, St. Louis

7:00 P.M.— **Banquet**

Lennox Hotel
Verna E. Bean, R.N.
President, A.A.N.A.
Presiding Officer

Invocation

Rev. C. C. Carnahan

Presentation of A.A.N.A. Award of Appreciation
Mae B. Cameron, *Receiving*
Director, School of Anesthesia
Ravenswood Hospital, Chicago

Government—As You Like It!

Milton Napier
Former Missouri State Senator, St. Louis

Thursday, September 20

9:00 A.M.— **General Session**

Kiel Auditorium, Arena Hall

Pauline Henry, R.N.
President, Illinois Association of Nurse Anesthetists
Presiding Officer

Surital Sodium Anesthesia

Mary H. Snively, R.N.
Chief Nurse Anesthetist
Duke Hospital, Durham, N. C.

Cardiac Resuscitation in the Operating Room

R. M. Hosler, M.D.
Educational Committee
Cleveland Heart Society, Cleveland

11:00 A.M.—**Anesthesia for the Surgical Treatment of Pulmonic and Mitral Stenosis**

Olive L. Berger, R.N.
Chief Nurse Anesthetist
Johns Hopkins Hospital, Baltimore

Discussion

C. Rollins Hanlon, M.D.
Professor of Surgery
St. Louis University School of Medicine, St. Louis

2:00 P.M.— **General Session**

Kiel Auditorium, Arena Hall
Virginia Futch, R.N.
President, Texas Association of Nurse Anesthetists
Presiding Officer

Complications of Anesthesia

E. O. Kraft, M.D.
Anesthesiologist
De Paul Hospital, St. Louis

3:00 P.M.—**Early Detection of Hypoxia**

James Elam, M.D.
Anesthesiologist
Barnes Hospital, St. Louis

4:00 P.M.—**Unfinished Business**

Adjournment

My Gift

To the Agatha Hodgins Educational *Loan* Fund

I hereby donate $_____to the Agatha Hodgins Educational Fund, which is "designed to extend financial assistance to graduate nurse anesthetists in obtaining further education and training to become qualified instructors, or to instructors who desire and need additional training to become better qualified."

Name_____

Address_____

(Checks should be made payable to: American Association of Nurse Anesthetists, for Educational Fund, and sent to: American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Illinois.)

ABSTRACTS

SWANN, H. G., AND BRUCER, M.: The sequence of circulatory, respiratory and cerebral failure during the process of death; its relation to resuscitability. Texas Reports Biol. & Med. 9:180-219, 1951.

"It is a textbook statement that the breathing fails long before the circulation. . . . We first became doubtful of this conclusion when studying the cardiorespiratory behavior of normal dogs made acutely anoxic by giving them 2.43 per cent oxygen to breathe. In these experiments, 41 per cent of dogs continued breathing after 'circulatory failure,' using as a criterion thereof the disappearance of the palpable femoral pulse. . . . The only type of overwhelming anoxic death in dogs in which the breathing consistently fails before the circulation is in the fulminating anoxia of breathing pure nitrogen. . . . The cause for this widespread misapprehension concerning the sequence of respiratory and circulatory failure during the process of death was suggested by us to be the use of general anesthesia in experimental studies. . . . If general anesthesia is used, the breathing does, in fact, fail before the circulation, but if anesthesia is not used, the breathing often continues beyond what was conjectured to be circulatory failure in many types of anoxic death of dogs. However, we cannot relate the cessation of breathing to the failure of the circulation until we can define the point at which the circulation fails. This definition has never been accurately made. One aim of this report therefore is to define circulatory failure in quantitative terms. . . .

"1. The sequence of circulatory, respiratory, and cerebral failure was determined during the process of death in dogs. Circulatory failure is herein defined as the point during the terminal collapse in blood pressure at which periodic insufflation of the lungs with oxygen just fails to restore the circulation. Respiratory failure is defined as the point at which apnea supervenes. Cerebral failure is defined as the point at which an irreversible cerebral insult is done by the anoxic experience. Four types of death were investigated: the fulminating anoxia of breathing pure nitrogen, the acute anoxia of breathing 2.43 per cent O_2 in N_2, carbon monoxide poisoning (one per cent CO), and obstructive asphyxia. The induced anoxia served as the general anesthetic in all experiments.

"2. In fulminating anoxia, O_2 insufflation uniformly succeeded in restoring the circulation when the systolic blood pressure was 105 mm. Hg or greater, but uniformly failed when it declined to 75 mm. or less, with 15 seconds, on the average, elapsing between the two points. Regardless of the time at which the two points appeared, the first point showed when circulatory failure was imminent and the second when it had just occurred.

"3. In fulminating anoxia, the breathing always fails before the circulation, 84 seconds, on the average, elapsing between respiratory and circulatory failure. Respiratory failure could not be clearly related to circulatory failure, regardless of what compo-

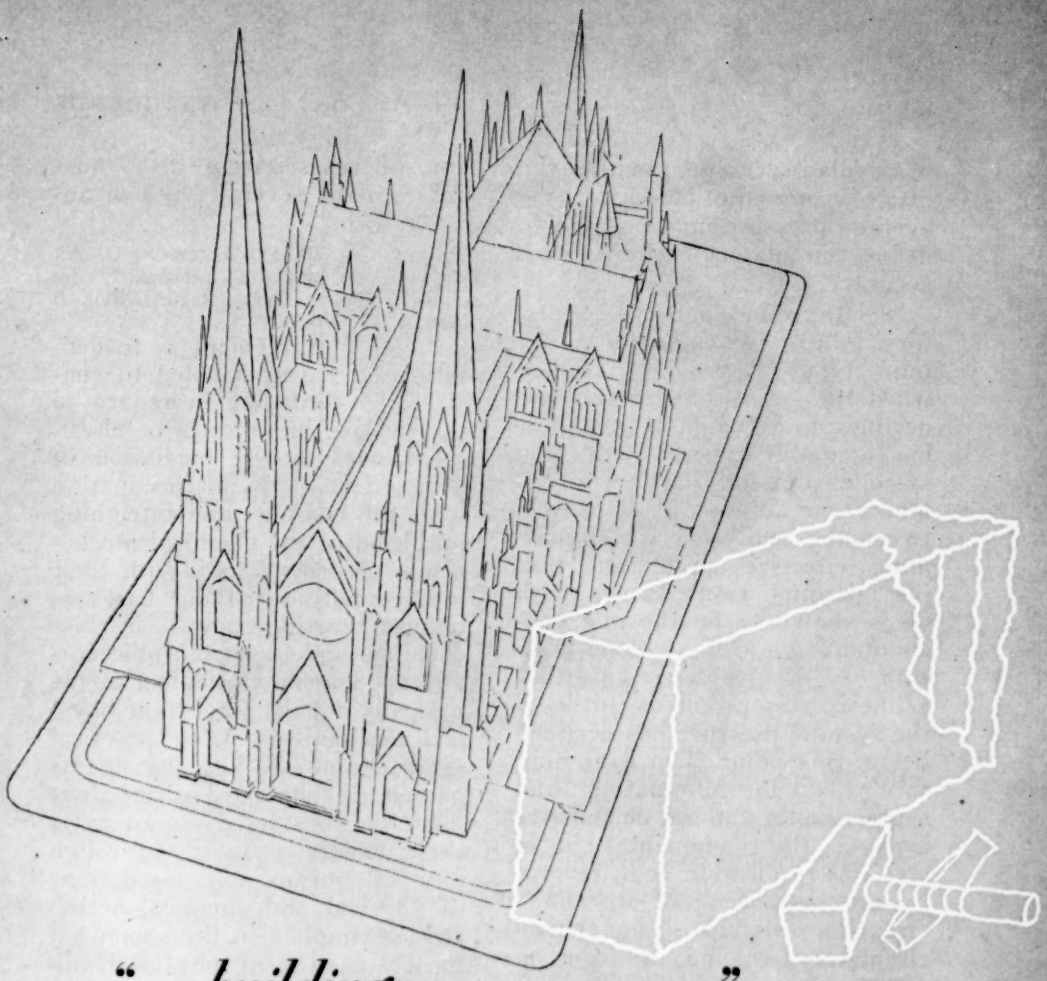
nent of the breathing pattern during the process of death was examined. The cerebrum failed at 6½ minutes after the onset of fulminating anoxia, the damage being so overwhelming at this time that no dog lived more than 2 days in spite of careful nursing and artificial feeding. But after 5½ minutes of exposure, apparently complete recovery of the dogs took place. All dogs in the latter two groups were resuscitated by O_2 insufflation and extrathoracic cardiac massage, because both apnea and circulatory failure had occurred before the overwhelming cerebral insult took place.

"4. In acute anoxia, all dogs were resuscitated with periodic O_2 insufflation, regardless of the duration of the anoxia, when the systolic blood pressure was 90 mm. Hg or greater. But when it declined to 55 mm. Hg, the attempt to resuscitate uniformly failed. On the average, 16 seconds elapsed between the two points. The breathing failed sometimes before, sometimes simultaneously with, and sometimes after circulatory failure, the latter phenomenon occurring in one-third of the cases. No cerebral insult was done if the dogs were resuscitated when just on the threshold of circulatory failure; but an overwhelming cerebral insult, causing death in a few days, was done when the dogs were resuscitated 1 minute after circulatory failure. This was independent of the duration of the acute anoxia; it was related only to the time of circulatory failure.

"5. In CO-poisoning, all dogs were resuscitated with O_2 insufflation when the systolic blood pressure was 100 mm. Hg or greater, but none was resuscitated if the pressure was allowed to fall to 40 mm. On the average, 32 seconds elapsed between the two points. As in acute anoxia, breathing sometimes failed before, sometimes concurrently with, and sometimes definitely after circulatory failure, the latter occurring in one-third of the cases. But three-quarters of the dogs died at from .1 to 15 days after the experience, exhibiting typical signs of anoxic decerebration. It is apparent that an overwhelming cerebral insult is usually done in CO anoxia before circulatory and respiratory failure. In many dogs, it was done at a time when the breathing and blood pressure were still very strong.

"6. In obstructive asphyxia, all dogs were resuscitated with O_2 insufflation when the systolic blood pressure was 105 mm. Hg or greater, but none was resuscitated if the pressure had fallen to 45 mm. or less. On the average, 28 seconds elapsed between the two points. Again, breathing movements ceased sometimes before, sometimes at the same time as, and sometimes definitely after circulatory failure, the latter phenomenon appearing in one-third of the tests. An overwhelming cerebral insult was done by the anoxic experience at 3 minutes, but not at 2 minutes, after the onset of circulatory failure.

"7. In none of the four types of death does the pattern of the terminal breathing furnish an exact prediction of circulatory failure. Furthermore, no component of the blood pressure except the systolic gives a sharp prediction of the imminence or fact



"....*building* A CATHEDRAL...."

A philosopher stood watching three stonecutters and of each in turn he asked: "What are you doing?" The first said: "I am cutting stone." The second: "Why, I am earning a dollar an hour!" The third said quietly: "I am building a Cathedral."

This is a very old and oft repeated story. We tell it again because its essence, the turn-of-mind of the third stonecutter, shared by chemists, explains the success of the American Chemical Society now celebrating its Diamond Jubilee. The nation's chemists with their deep professional interest far beyond any immediate task, have abundantly fulfilled their credo of "*fostering public welfare and education, aiding the development of our country's industries and adding to the material prosperity and happiness of our people.*"

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of circulatory failure; neither the diastolic nor the pulse nor the average pressure may be used to define circulatory failure with accuracy.

"8. In round figures, circulatory failure is imminent in all four types of anoxia studied when the systolic blood pressure declines to 100 mm. Hg, and it has actually occurred when the systolic pressure declines to 50 mm. Some 20 seconds elapse between the two points. The minimum effective circulation that just permits resuscitation with O_2 is shown to be the one concomitant to a systolic blood pressure of 100, thus suggesting that artificial respiration is futile if the systolic pressure has declined below this point. The data indicate that in fulminating and acute anoxia and in obstructive asphyxia the fundamental aim of artificial respiration is to reverse by reoxygenation the process of circulatory failure. The critical circulatory change, uniform in all four types of death, is suggestd to be anoxic failure of the myocardium. . . .

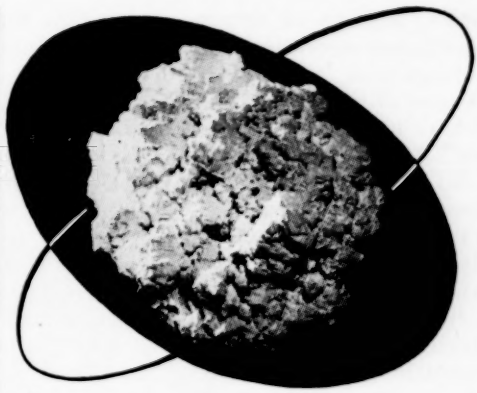
"9. Only in fulminating anoxia does apnea consistently precede circulatory failure.

"10. An irreversible cerebral insult, caused by the anoxia, takes place in fulminating and acute anoxia and in obstructive asphyxia definitely after circulatory and respiratory failure. But in CO-poisoning, it usually precedes circulatory and respiratory failure. . . .

"11. Because the 'weakest link' during the process of death differs with each type of anoxia, being now the breathing, now the circulation, and now the cerebrum, it is apparent that the aim of resuscitation also must differ in the several types of anoxic death."

NASH, JOE B., AND EMERSON, G. A.: Drug effects mediated proximately by physical actions. Texas Reports Biol. & Med. 9:59-75, 1951.

"Lack of agreement as to definition of a *drug* has led to considerable confusion in regard to the relative importance of physical factors in the mediation of drug effects. . . . Preoccupation with the complex and intriguing problems of the chemical mechanisms of drug action, with their intellectually satisfying bases of factual starting points in biochemical and biochemorphic corollaries, engenders neglect of the basically equally important physical mechanisms. In a practical sense, some 20-30% of agents named in standard drug lists must be considered. . . to exert their effects primarily through physical means. . . . Gradations of physical and chemical activities are implied in the somewhat loosely used term, physicochemical. . . . To judge arbitrarily. . . whether a given drug mechanism is physical or chemical depends on the probability of physical effects or chemical reaction: it is not probable that the inert gas, xenon, reacts chemically in the body, therefore its effects are probably physical; conversely, it is not probable that the highly reactive, unstable phenalkanolamine, *l*-epinephrine, exerts its effect through a physical action, even though the equally reactive, unstable *d*-isomer is but 1/20th as effective in some physiologic actions. . . . Effects of drugs are conveniently divided into local and systemic actions, the latter implying absorption and distribution of the drug. Within these



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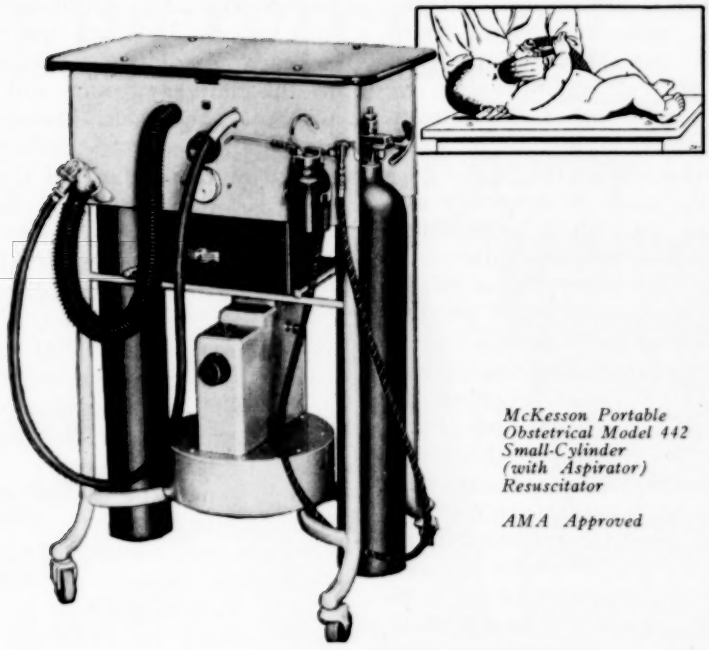
two categories, actions of drugs may be considered according to their uses: diagnostic, prophylactic, curative and alleviative. . . . *Locally*, the actions of ethyl chloride against *Ancylostoma braziliense* and of hypertonic NaCl against *Enterobius vermicularis* represent effects of physically acting agents truly analogous to those of chemically acting agents approaching the ideal of magna therapia sterilisans. The local chemotherapeutic effect of CO_2 snow on lupus and leprosy is probably proximately physical, but involves secondary chemical mechanisms; so, also, the nonspecific effect of intramuscular injections of distilled water or of homeopathic dilutions of ethylene disulfonate. . . . Effects of ether on experimental virus infections are most probably due to physical factors. . . . Systemic effects of saline and non-electrolyte solutions of varying tonicity are so widely recognized and applied clinically that no extensive discussion is needed. . . . Therapeutic applications of osmotic effects are made in shock, hemorrhage, edema, skull fractures, and diuresis, many of which yield results superior to any effects obtainable by agents acting through chemical mechanisms, as, for example, the pressor amines. Colloidal solutions which have been used to restore blood volume or to exert osmotic effect include those of gelatin, acacia, pectin, dextran, polyvinyl alcohol and hemoglobin, as well as human and despeciated plasma proteins. . . . The nitritoid reaction following intravenous use of agents precipitable at the pH of blood plasma is ordinarily referred to a physical effect. Injection of large particles may cause thrombosis; experimental use has been made of this by Dawson (1939) as a convenient method of decerebration. Hypertonic solutions, such as NaCl or glucose, or surface-active agents, such as Na morrhuate or other soaps, are used clinically to sclerose veins. Nerve block by alcohol injection is chiefly due to physical effects. . . . Effects of O_2 given at tensions above the normal partial pressure in the atmosphere are proximately mediated physically, since with normal alveolar function, hemoglobin becomes nearly completely converted to oxyhemoglobin under normal conditions. In the presence of pulmonary edema, increased tensions of O_2 will result in better diffusion through the alveolar fluid barrier. Helium, replacing N_2 in mixtures with O_2, will permit better passage of gas around obstructions of the airway. . . . Certain reflex respiratory stimulants may also act physically. . . . Lipolytic anesthetic agents appear to act physically, since their *in vitro* inhibitory metabolic effects are produced only by tensions several times greater than those effective in producing narcosis in the intact brain. . . ; this is not invalidated by inhibitory effects noted in perfused preparations. . . . since arteriovenous difference in O_2 tension in such preparations may not reflect brain metabolism alone. It is generally accepted that the lipolytic anesthetics are not metabolized; closed-circuit anesthesia may be maintained for long periods without addition of greater amounts of anesthetic agent than can be accounted for by loss through diffusion from the skin. Alcohol is slowly me-



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tabolized in the body, in contrast to its rapid physiologic effects. Bromide and magnesium ions probably act through physical means on cell membranes. Xe cannot act by other than proximately physical means to exert its anesthetic effect. . . . N_2O, as frequently used in dentistry and obstetrics, and N_2 in experimental neuropsychiatric studies. . . . certainly owe their major effects to the physical effect of producing acute anoxic anoxia. Challenging physical theories of narcosis have been proposed by Spiegel *et al.* (1938), and Burge (1938). No chemical theory of narcosis offers an explanation of the lack of anesthetic activity of cyanides and other enzyme inhibitors. . . . Cold cream is 'cold' through evaporation of its high water content. . . . One must agree with the statement of Krantz and Carr (1949) that, 'A knowledge of pharmacodynamics is essential often as a basis of pharmacotherapy.' . . ."

McMANN, WALTER: Curare with general anesthesia for vaginal deliveries. Am. J. Obst. & Gynec. **60**:1366-1368, Dec. 1950.

"Last August, with some trepidation, we used curare as an adjuvant to obstetric anesthesia for the first time. . . . Quite often in delivery it is necessary to put the patient under deep or surgical anesthesia in order to relax the perineum. . . . Deep anesthesia is not good for the parturient woman. . . . The effect on the baby of deep anesthesia is well known. . . . It was the problem of deep anesthesia that led us to the use of curare in our delivery room. To date, April 1, 1950, we have used curare for 100 deliveries, including low forceps 60, midforceps 33, spontaneous 4, and breech 3. When the patient is ready for delivery, she is taken to the delivery room and cyclopropane anesthesia started. After she is draped and catheterized, an estimate is made of the firmness of the perineum and the levators. . . . Eighty units of curare are then given. If there is no relaxation in ninety seconds, 20 more units are given. We have found that usually 100 units of the drug is the optimum dosage. As soon as the injection of curare is begun the cyclopropane is discontinued and only oxygen given. When the cyclopropane is discontinued, the bag on the machine is not emptied. Oxygen is continued throughout the delivery. Very often that is all that is necessary for even the finishing of the repair of the perineotomy.

"Results have been good. No baby has shown any effects from the drug whatsoever. In fact, because of the discontinuance of the anesthetizing agent we have had more of them cry immediately upon delivery than before. Not often is actual anesthesia given for more than five minutes. . . . With two exceptions we found the relaxation remarkable, so much so that on numerous occasions it has been a cause for comment. Because of this relaxation most of the episiotomies were shallow, and the transversus perinei was not severed. All episiotomies were midline. . . . No patient had to have Prostigmine to counteract the effects of curare. One, because of marked respiratory depression, was given forced oxygen."

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BOOK REVIEWS

Psychology Applied to Nursing. By Lawrence A. Averill, Ph. D., formerly Professor of Psychology, Massachusetts State Teachers College, Worcester, Mass., and Florence C. Kempf, R.N., B.S., A.M., Professor of Nursing Education, Michigan State College, East Lansing, Mich. Ed. 4. Cloth. 481 pages, 38 illustrations. Philadelphia: W. B. Saunders Co., 1951.

This text has been revised to include newer phases of psychology of and for nurses. The mental hygiene approach has been used by the authors. Psychology in relation to the aged and the handicapped are new topics. References, suggested readings, and thought problems for the student follow each chapter. Indexed.

Chloroform. A Study after 100 Years. Edited by Ralph M. Waters, M.D. Cloth. 138 pages, 35 graphs, 32 tables. Madison, Wis.: University of Wisconsin Press, 1951. $2.75.

Speculating that had chloroform been introduced recently it might now be accepted with enthusiasm, a group of workers studied it by present methods. At the University of Wisconsin, under the guidance of Waters, many persons contributed to the research.

The effects of chloroform on hepatic function, renal function, and the cardiovascular system were subjected to laboratory and clinical investigation. Analyses were made of the amounts of chloroform in blood and respired atmosphere.

The conclusions drawn include the following statements: "We certainly do not advocate any widespread revival of the use of chloroform. On the other hand, we can scarcely concur in the marked fear of the agent which seems to prevail at present. . . ." "Its relatively nonirritant effects (as compared with ethyl ether) upon the reflexes which inhibit breathing and prevent the inhalation of sudden high concentrations, puts it in a class with cyclopropane where the responsibility for overdose rests entirely upon the administrator."

DeLee's Obstetrics for Nurses. By M. Edward Davis, M.D., Joseph Bolivar DeLee Professor of Obstetrics and Gynecology, University of Chicago; Obstetrician to The Chicago Lying-In Hospital and Dispensary; Member of the Maternal and Child Health Advisory Committee of the Children's Bureau, Federal Security Agency, and Catherine E. Sheckler, R.N., M.A., Assistant Professor of Nursing Education, The University of Chicago; Member of the Maternal and Child Health Advisory Committee of the Children's Bureau, Federal Security Agency. Ed. 15. Cloth. 673 pages, 387 illustrations. Philadelphia: W. B. Saunders Co., 1951.

Since obstetric anesthesia is often a considerable part of the work of an anesthetist, it would seem wise for her to refresh her memory occasionally concerning obstetric nursing. This fifteenth edition of DeLee's book has been extensively rewritten with a "hope it has retained much of the wisdom and charm born of fifty years' experience of that master obstetrician and teacher, Joseph Bolivar DeLee, and his associates at the Chicago Lying-In Hospital."

Thirteen pages are devoted to the subject of anesthesia and analgesia. It is not clear whether these are included merely for the information of the nurse or whether, from these instructions, she is to learn how to administer the agents mentioned. If the latter is intended, it seems that the

instructions are inadequate and might give a false sense of security to the uninitiated. For instance, although the approximately 250 words devoted to ether include the statement, "At no time may the patient become cyanotic, be completely relaxed, or have stertorous respiration, a very rapid pulse or dilated pupils, for these are danger signals of too much anesthetic," at no point is instruction given on signs of anesthesia, how to maintain an adequate airway, and other such seemingly important information. Nor are methods given for correcting "cyanosis, stertorous respiration, rapid pulse or dilated pupils." It would seem that either more or less should be said on this subject.

LUMBAR PUNCTURE AND SPINAL ANALGESIA. By R. R. Macintosh, M.A., D.M., F.R.C.S. (Edin.), D.A., Nuffield Professor of Anaesthetics, University of Oxford; Civilian Consultant in Anaesthetics, Royal Air Force; Examiner for the D.A.; Anaesthetist, United Oxford Hospitals; Fellow of the Faculty of Anaesthetists, Royal College of Surgeons. Cloth. 149 pages, 111 illustrations. Baltimore: Williams & Wilkins Co., 1951. $4.50.

The text of this book seems to be incidental to a large number of sketches, schematic drawings, and photographs, some in color. The anatomy as it pertains to spinal puncture, discussion of the cerebrospinal fluid, and technics for administering spinal anesthetics are presented. Sterilization of equipment, complications, and precautions are among the other subjects discussed. References follow each chapter.

CLASSIFIED ADVERTISEMENTS

ANESTHETIST WANTED: 250 bed hospital. Five anesthetists employed. Salary and maintenance. Apply: Thelma Dorum, Illinois Masonic Hospital, 836 Wellington, Chicago 14, Ill.

NURSE ANESTHETIST: General hospital, 450 beds, beginning salary $330 per month, two weeks' annual vacation, sick leave. Apply: Personnel Office, The Queen's Hospital, Honolulu, Hawaii.

WANTED. Nurse anesthetists. 250 bed hospital, seven nurse anesthetists employed, opening for additional anesthetists. Department under medical supervision. Attractive salary; no maintenance. Majority of surgical work performed during the morning hours; small amount of emergency work. For particulars write: Anesthesiologist, Scott and White Memorial Hospitals and Scott, Sherwood and Brindley Foundation, Temple, Texas.

NURSE ANESTHETIST: Starting salary $288 with annual increases. Children's Hospital Society, 4614 Sunset Blvd., Los Angeles 27, Calif.

VACANCY: Department of anesthesiology, directed by diplomate of Board of Anesthesiology. Write: Frank Cole, M.D., 2430 Lake St., Lincoln, Neb.

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WANTED: Nurse anesthetist for clinic in Midwestern city. Congenial and capable surgical staff. Salary open. Apply: Administrator, Medical Associates, Dubuque, Iowa.

TWO ANESTHETISTS: Excellent equipment, new facilities, top personnel policies, excellent salary. Vacationland area of Michigan. Apply: Superintendent, Mercy Hospital, Benton Harbor, Mich.

WANTED: Anesthetist for surgery and obstetrics. 200 bed, modern hospital. Pleasant working conditions; good hours. Liberal salary, vacation, and personnel policies. For particulars, write: Chief Anesthetist, Jameson Memorial Hospital, New Castle, Pa.

WANTED: Nurse anesthetist. General hospital, 700 beds. Starting salary, $3600 per annum; maximum, $4000; vacation and sick time; full maintenance provided. Address: Medical Director, Newark City Hospital, Newark, N. J.

NURSE ANESTHETIST for 150 bed community hospital. Four nurses, full time M.D. All agents and technics. Good opportunity for advanced training. Salary $225 per month with full maintenance and one month's vacation. Two and one-half hours from Boston and New York. Write: G. J. Carroll, M.D., Wm. W. Backus Hospital, Norwich, Conn.

WANTED: Nurse anesthetist, Association member or examination eligible preferred. 500 bed teaching hospital. Presently on forty-eight hour week; starting salary $4,323.20 per year. Maintenance available at $980. Periodic salary increases every eighteen (18) months. Twenty-five (25) days paid leave and fifteen (15) days paid sick leave per year. Medical anesthesiologist in charge. University of Virginia Hospital, Charlottesville, Va.

NURSE ANESTHETISTS (2): A.A.N.A. membership required. Salary $360 per month, plus meals, private room and bath in new women's residence, and laundry. Social Security and private pension plan. Apply: Administrator, The Reading Hospital, Reading, Pa.

WANTED: One nurse anesthetist, St. Anthony Hospital, Rockford, Ill. Salary plus room and board. Large midwestern city. Working hours daily 7:30 A.M. to 12:00 A.M. On call twice a week and every third week end. Address reply to: E. V. Platt, M.D., St. Anthony Hospital, 1401 E. State St., Rockford, Ill.

NURSE ANESTHETIST: 70 bed general hospital employing two anesthetists. Salary $350 per month plus maintenance. Work schedule allows ample time off duty. Apply: Superintendent, Helena Hospital, Helena, Ark.

NURSE ANESTHETIST. Apply Director of Department of Anesthesia, Abington Memorial Hospital, Abington, Pa.

NURSE ANESTHETISTS for surgery in 485 bed general hospital. Forty (40) hour week, not on call. Beginning salary $306 to $375 in five years. Vacation, sick leave, and retirement plan. Contact Assistant Superintendent, Highland-Alameda County Hospital, 2701 14th Ave., Oakland, Calif.

WANTED 2 NURSE ANESTHETISTS: 300 bed general hospital. Limited night call. $300 per month plus full maintenance. Apply: Superintendent, Augustana Hospital, 411 W. Dickens Ave., Chicago 14, Ill.

NURSE ANESTHETIST to work with anesthesiologist in 300 bed hospital. Five anesthetists at present. Apply: Chief, Anesthesia Department, Mercer Hospital, Trenton, N. J.

NURSE ANESTHETISTS for 340 bed A.M.A. and A.C.S. approved hospital. Department headed by physician anesthetist. Room available in Nurses Residence. Mount Sinai Hospital, 2745 W. 15th Pl., Chicago 8, Ill.

ANESTHETIST: Nurse, A.A.N.A. member, for 63 bed modern hospital. Two anesthetists employed. Good salary and hours; liberal sick leave, vacation, and holiday program; good working conditions. Apply: Administrator, Centre County Hospital, Bellefonte, Pa.

NURSE ANESTHETIST for oral surgeons' office. Pleasant working conditions; good hours. H. M. Seldin, D.D.S., 57 W. 57th St., New York 19, N. Y.

WANTED: Nurse anesthetists for 250 bed general hospital. Salary range $300 to $325 with meals and laundry. Please give full information. Apply to: Methodist Hospital, Memphis, Tenn.

NURSE ANESTHETIST for 135 bed new general hospital. Excellent surroundings and working conditions; lovely community. Salary $300 per month with full maintenance. Chambersburg Hospital, Chambersburg, Pa.

NURSE ANESTHETISTS: Two needed for 60 bed general hospital, A.M.A. approved. Salary open. Write, phone, or wire Doctors Hospital, Milwaukee 8, Wis.

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WRITE: DIRECTOR, MEMORIAL HOSPITAL, ELMHURST, ILLINOIS

WANTED: Nurse anesthetists for general hospital. Must be able to administer latest types of anesthetic agents. Salary $290 to $325 per month plus full maintenance. Annual vacation and sick leave granted. Retirement benefits available if desired. Apply: Superintendent, Robinson Memorial Hospital, Ravenna, Ohio.

WANTED: Nurse anesthetist (A.A.N.A. member) for 350 bed general hospital. Work with three other anesthetists, every fourth night on call, every fourth week end off. No resident accommodations. Liberal starting salary. Reply to: L. A. Hohener, R.N., Associate Director of Nursing Service, Mercy Hospital, Baltimore 2, Md.

NURSE ANESTHETIST: Starting salary $319. Department directed by medical anesthetist. Apply: Superintendent, Minneapolis General Hospital, Minneapolis, Minn.

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NURSE ANESTHETIST: For 162 bed hospital expanding to 231. Convenient to Pittsburgh (one hr.). Four anesthetists employed. Salary $300 monthly with periodic raises and maintenance plus sick leave, holiday time, and month vacation. Excellent working conditions. Charleroi-Monessen Hospital, North Charleroi, Pa.

NURSE ANESTHETIST (Member A.A.N.A.): 493 bed general hospital, with approved school for nurse anesthetists. Beginning salary, experienced, $316; for recent graduates, $291. Forty hour week, twenty-four hour anesthesia coverage of eight hour shifts. Five per cent premium p.m. and night duty. Time and a half for overtime. Annual vacation, accumulative sick leave, and retirement benefits. Quarters available in anesthetists' residence $10 per month. Uniforms furnished. Write: Anesthesia Department, Hurley Hospital, Flint, Mich.

ANESTHETIST: 300 bed hospital; four other nurse anesthetists; no obstetrics; excellent personnel policies. Apply to: Administrator, Jewish Hospital, Saint Louis, Mo.

Opportunity for NURSE ANESTHETIST in Hawaii. Apply to: Administrator, Kapiolani Maternity and Gynecological Hospital, Honolulu, T. H. Travel expense from West Coast advanced. Hospital situated ten minutes from downtown Honolulu.

HEAD ANESTHETIST WANTED in a busy suburban hospital near Chicago. New nurses' residence or apartment furnished for married anesthetist. Good working conditions. Salary open. Apply: Box C-15, Journal A.A.N.A., 116 S. Michigan Ave., Chicago 3, Ill.

ANESTHETISTS WANTED: Busy suburban hospital near Chicago. New nurses' residence or apartment furnished for married anesthetist. Starting salary $325 per month and complete maintenance. Apply Box C-20, Journal A.A.N.A., 116 S. Michigan Ave., Chicago 3, Ill.

NURSE ANESTHETIST: Excellent opportunities during summer months and also permanent openings. Portland is a beautiful seacoast city with many lakes nearby. Two hours from Boston by train. Apply: Personnel Department, Maine General Hospital, Portland, Maine.

Four positions available for NURSE ANESTHETISTS owing to expansion of hospital. Saturday and Sunday off, minimal night call. Initial salary commensurate with previous experience with minimum $315 per month. No maintenance but assistance in obtaining housing provided by hospital. Memorial Hospital, 444 E. 68th St., New York 21, N. Y.

WANTED: Experienced nurse anesthetist, salary $350 with maintenance; $400 without. No OB call. Idaho Falls L. D. S. Hospital, Idaho Falls, Idaho.

ANESTHETIST: Staff position for large, progressive, general city hospital affiliated with Western Reserve Medical School. Hospital conveniently located from downtown city. Subsistence and quarters available in Nurses' Residence at very moderate cost. Salary open. Stanley A. Ferguson, Superintendent, City Hospital, 3395 Scranton Rd., Cleveland 9, Ohio.

WANTED: Nurse anesthetist for 140 bed general hospital. Will be responsible for supervising other personnel of the department. No night calls. Salary open. Cleveland, Ohio, Box 2279.

NURSE ANESTHETIST for 40 bed hospital. $500 per month. Every other week end off from Friday noon to Monday morning. Has opportunity to earn fee for service basis with two other smaller hospitals on call when other anesthetists off duty. French Clinic and Hospital, San Luis Obispo, Calif.

WANTED IMMEDIATELY: NURSE ANESTHETISTS for 700 bed general hospital. Pleasant working conditions. Salary open. Complete maintenance. Liberal employee benefits. Apply: Personnel Director, Grady Memorial Hospital, 36 Butler St., S. E., Atlanta, Ga.

NURSE ANESTHETIST WANTED: 250 bed general hospital. $300 per month, full maintenance, vacation, sick leave, overtime pay, new modern surgery. Ohio Valley Hospital, Steubenville, Ohio.

ANESTHETISTS: Organizing new department obstetric anesthesia. 373 bed, fully approved general hospital. Completing plans for 200 bed expansion. Large active obstetric service; excellent equipment; 44 hour week; vacation and sick leave policies; salary open. Apply: Personnel Director, Aultman Hospital, Canton, Ohio.

TWO NURSE ANESTHETISTS: 150 bed hospital; $350 per month and full maintenance. Department directed by medical anesthetist. State experience. Apply to: Director of Anesthesia, St. Francis Sanitarium, Monroe, La.

NURSE ANESTHETISTS: Forty hour week. No split hours. Salary $325-$375. 190 bed general hospital. Located in university city across the Bay from San Francisco. Department headed by anesthesiologist. Apply: R. H. Johnson, M.D., Herrick Memorial Hospital, Berkeley, Calif.

ANESTHETIST for 340 bed hospital. Starting salary $300 with complete maintenance. Periodic increases, six holidays, annual vacation with pay, sick leave, and hospitalization provided. Only twenty miles from Virginia Beach. Apply: Clarene Carmichael, R.N., Director of Anesthesia, Norfolk General Hospital, Norfolk 7, Va.

NURSE ANESTHETIST. 300 bed hospital. Opening for a nurse anesthetist. Write direct to the Personnel Director, Providence Hospital, Washington 3, D. C.

WANTED: Anesthetists, four. 450 bed teaching hospital. Department directed by medical anesthesiologist, staffed by medical resident personnel and four nurse anesthetists. Desirous of increasing staff to eight nurse anesthetists. College town. $300 per month with periodic increases. Full maintenance. Liberal vacation and sick leave. Apply: C. A. Robb, Superintendent, Roper Hospital, Charleston, S. C.

St. Christopher's Hospital for Children, Philadelphia 33, Pa., desires a well qualified NURSE ANESTHETIST who has had experience in pediatric anesthesiology. Salary and maintenance.

WANTED: Nurse anesthetist for 75 bed hospital near Portland, Oregon, and Seattle. Starting salary $350. Write for particulars. St. John's Hospital, Longview, Wash.

WANTED: Nurse anesthetist. Starting salary $300. Maternity and general service. Sick leave and paid vacation, also six national holidays paid. Eighty bed, fully approved hospital. Call rotated with three nurse anesthetists, under medical supervision. Apply: Lillian M. McDonald, R.N., Superintendent, Salem General Hospital, Salem, Ore.

NURSE ANESTHETIST for 100 bed hospital. Full maintenance if desired. Salary open. Hospital located near University of Minnesota. Apply: Administrator, St. Andrew's Hospital, Minneapolis, Minn.

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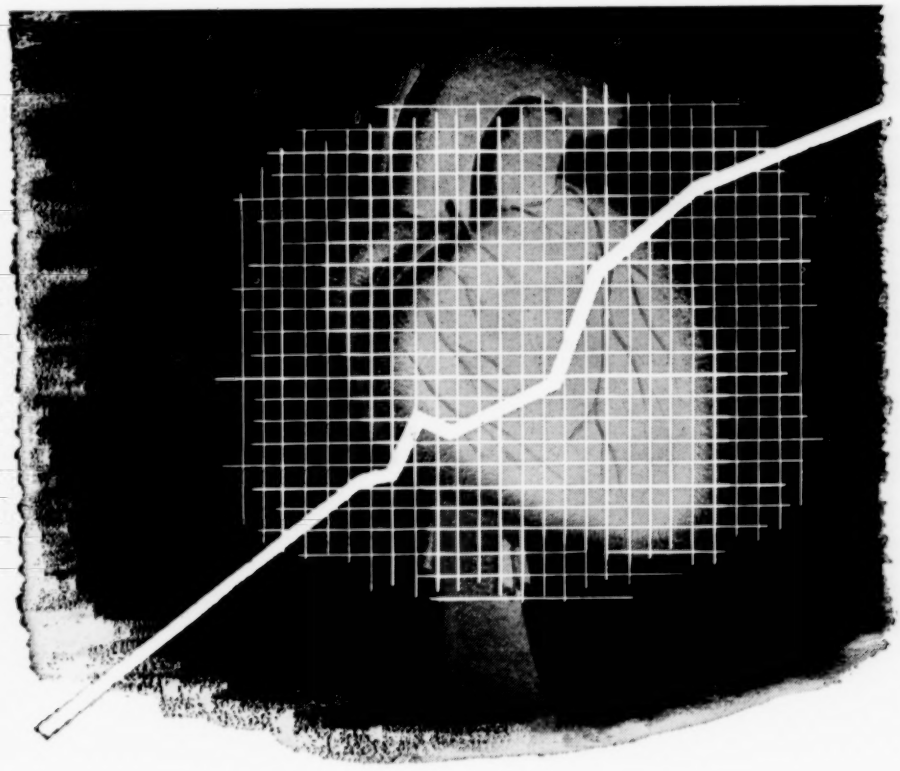
CONTRIBUTIONS to the JOURNAL should be typewritten, double-spaced, on one side of white typewriter paper. The author's name and hospital or university affiliations should be typed on the first page.

Illustrations submitted with an article should be glossy prints. Each illustration should carry a number and the author's name on the back. Legends for illustrations should be typed on a separate page at the end of the manuscript.

References should be complete and should also be typed on a separate page. Superior figures should be used to indicate the placement of the references in the text.

Manuscripts should be sent to the Editor, Journal American Association of Nurse Anesthetists, 116 S. Michigan Ave., Chicago 3, Ill.



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